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BS ISO EN 14001: 2004
A critical review

by

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CONTENTS

CONTENTS.....	I
Figures.....	i
Tables.....	ii
ABSTRACT.....	III
INTRODUCTION.....	I
PART 1: BACKGROUND	2
Environmental concepts and issues in the United Kingdom.....	2
Background to the Standard	4
PART 2: THE ISO 14001 STANDARD	7
Certification.....	7
Policy	8
Planning.....	8
Implementation and operation	9
Checking	10
Management review	10
Review information from two certified organisations	10
PART 3: IMPLEMENTATION OF ISO 14001: A CASESTUDY.....	13
The Casestudy: Aukett Fitzroy Robinson	13
Setting up of the implementation committee	13
Certification.....	13
Policy	18
Legal and other requirements.....	18
Framework	18
Aspects.....	19
PART 4: RESULTS OF AUKEIT FITZROY ROBINSON'S 2006 AUDIT	22
Energy	22
Total energy due to fossil fuel using fuel bills.....	22
Energy use due to appliances	26
Energy due to Staff travel for work purposes.....	29
Water	29
Waste	30
Supplies	31
Community.....	32
DISCUSSION	36
CONCLUSION.....	38
BIBLIOGRAPHY AND OTHER REFERENCES	39
APPENDIX 1: INTERVIEWS AND CASESTUDY INFORMATION.....	I
APPENDIX 2: ENERGY	VI
APPENDIX 3: WATER.....	IX
APPENDIX 4: WASTE	X
APPENDIX 5: SUPPLIES/SPECIFICATION	X

Figures

Fig. 1: Graph showing UK and World ISO 14001 certificate numbers since 1995.....	5
Fig. 2: Graph showing top ten countries certificates in 2005.....	6
Fig. 3: Devonshire St. Basement to 1 st floor plans showing survey work	14
Fig. 4: Devonshire St. 2nd to 4th floor plans showing survey work.....	15

Fig. 5: Regent St. 1 st floor plans showing survey work.....	16
Fig. 6: Regent St. 2nd to 3rd floor plans showing survey work.....	17
Fig. 9: Graph showing temperature in the first rear office, Regent St. compared with external.....	25
Fig. 10: Graph showing temperature in the third floor office, Regent St. compared with external.....	25
Fig. 11: Graph showing temperature in the first rear office, Devonshire St. compared with external.....	26
Fig. 12: Bar chart showing estimated annual carbon emissions for the most common workstations in AFR.....	27
Fig. 13: Bar chart showing energy consumption over 24 hours for monitors used at AFR.....	27
Fig. 14: Bar chart showing annual energy consumption due to appliances used in teapoints at AFR.....	28
Fig. 15: Bar chart showing annual energy consumption due printers, plotters and scanners at AFR.....	29
Fig. 16: Bar chart showing water consumption at AFR for 2006.....	30
Fig. 17: Bar chart showing paper waste consumption at AFR for 2006.....	31
Fig. 18: Pie chart using invoice survey information to show significant types of supplies at AFR 2006.....	32

Tables

Table 1: List of AFR's 'Aspects' showing the extent of control they have over them.....	20
Table 2a: First half of AFR's list of 'Aspects' showing objectives, targets, monitoring and measuring for 2007 and beyond. (enlarged version in appendix 1).....	33
Table 2a: Second half of AFR's list of 'Aspects' showing objectives, targets, monitoring and measuring for 2007 and beyond. (enlarged version in appendix 1).....	34

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ABSTRACT

This report reviews BS EN ISO 14001: 2004 to assess its use in making offices more energy efficient and generally more sustainable. It uses the implementation of the standard into the architects' practice, Aukett Fitzroy Robinson, as a case study as well as interviews with accredited assessors and other organisations who have been certified. ISO 14001: 2004 is an international standard detailing how to set up an environmental management system, BS EN ISO 14001: 2004 being the UK ratified version. It is possible but not necessary to be independently certified. Any body can provide certification but there are accredited certifiers, accredited for specific organization types and in specific countries. Existing UK accreditation certificates are available on the UKAS website. Architecture is covered under the 'construction' type.

To qualify for certification, an organisation needs to have:

- an environmental policy,
- a register of environmental aspects,
- a register of applicable legal requirements,
- a list of objectives and targets and
- a framework for implementing, monitoring, reviewing, correcting and updating the above under the responsibility of a senior manager.

There is limited guidance in the standard about setting the aspects and extensive knowledge of environmental issues is needed to determine them.

To quantify significant aspects in relation to the casestudy's office activities, an audit was carried out. The intention is to carry out this audit annually. The results of the first audit for building energy, water and waste were all higher than typical and some excessively. Table 2 at the end of Part 4 used the information from the audit to set objectives and targets for each one and identifies how these are to be monitored and measured to indicate improvement. The targets are set deliberately low for the first year so that resources can be spent on assisting and improving implementation across the office. The next step is to appoint the accredited auditor and carry out a gap analysis with the intention of going for full certification in the new year, 2008.

The standard does offer a comprehensive system, with the exception of social sustainability issues, but suffers from being so generic that it requires expert help to implement for those with little environmental knowledge. A certified system, supported by an accredited auditor, should give clients confidence that an organisation is doing its best to improve environmental impacts but this would depend on the competence of the auditor to both advise on implementation and monitor that it is being carried out. Finally, the current low cost of carbon trading could affect take up. Currently it would be cheaper to pay to offset all AFR's carbon emissions than implement the system. This should sort itself out in time as the price of carbon trading reaches a more meaningful level. For the standard to be easily used by small businesses, there needs to be country and organisation type specific information for all the managed elements of the standard available in a recognised location at low or no cost.

INTRODUCTION

The standard ISO 14001 has been in existence for 11 years and the new version, first issued in 2004, is beginning to take a foothold. This important piece of international legislation was created to give a method for maintaining an environmental management system, (EMS), which could be applied to any type or size of organisation anywhere in the world.

This report reviews the United Kingdom, (UK) version of the standard: BS EN ISO 14001:2004 and takes one medium sized company's attempt at implementation as a casestudy. The subject of the casestudy is an architects' practice called Aukett Fitzroy Robinson, (AFR), and implementation of ISO14001 into their two London offices: in Devonshire Street and Regent Street. They have been working towards adopting the standard since September 2006 and hope to be certified compliant by the beginning of 2008.

With the help of this casestudy, interviews with certified organisations and with potential auditors, this report endeavours to find out why a company would need an environmental management system, why they would choose ISO 14001 in particular and what issues may arise from adopting the standard and seeking independent certification.

There are four parts to the report. The first part is a background section included to put the standard into its global context and its context in relation to the UK in particular. This is followed by a second part, a detailed review of the standard itself with the help of some interviews from organisations who have already achieved certification. The third part looks at how the casestudy is attempting to implement the standard and the final part looks at the casestudy's first internal audit for issues related the measuring and monitoring of environmental impacts, how these might be benchmarked to suit national targets and how objectives and targets might be set to mitigate them. Finally there is a discussion section which looks at findings from all the sections together, leading to a conclusion with recommendations for other companies taking this route and any suggestions about how the standard might be improved.

Having given a brief summary of the reports contents, now follows Part I which begins with a section on current environmental issues in the UK which the standard should help to mitigate, followed by a short history of the standard.

PART I: BACKGROUND

Environmental concepts and issues in the United Kingdom

Environmental issues represent one dimension of sustainable development. The other two are social and economic as proposed in the 1987 Bruntland Report¹ from which this much quoted text comes:

“Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development does imply limits - not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities.”

Environmental issues are concerned with emissions to air, land and water which could affect human life, all living things and indeed the nature of the planet itself. The environment provides the raw materials and resources to sustain life or support human lifestyles.

There is strong evidence for human-induced global warming on the basis of carbon dioxide and temperature records, recent from sources like those taken at the Mauna Loa observatory in Hawaii², as well as historic ice core and dendrochronology records collected in the IPCC report entitled “Climate change: A scientific basis”³. The main cause of carbon dioxide production is the burning of fossil fuels. There is some evidence that supplies of oil and natural gas have peaked or are on the verge of peaking in the next 10-20 years as first propounded by Dr. Hubbert in 1949⁴.

We in the UK make more than our fair share of carbon emissions. To this end the Government is committed to a 60% reduction in carbon emissions by 2050 from 1990 levels.⁵ Using US census bureau information it can be shown that in the year 2000 the UK was responsible for 2.3%⁶ of the world's carbon but has only 1.0% of the world's population. A 60% reduction would mean in real values a drop of about 63.3MtC⁷ by 2050 from 158.2MtC in 2000. National Statistics show that there were 1.64million VAT-based businesses in the UK in 2006⁸. A rough calculation shows that if each those businesses could reduce its carbon emissions by 38.6tC, the UK could meet its 2050 commitment without recourse to any other sector. This is not to suggest that businesses alone should be responsible for this level of reduction. The figure is included to give an idea of scale.

The major consumers of energy are transport and space heating in buildings. Transport accounted for 34% of UK total energy consumption in 2001. Space heating accounted for

¹ G. Bruntland. (Ed.) *Our common future: The World Commission on Environment and Development*. 1987. Oxford University Press.

² Bacastow, Keeling and Whorf. *Seasonal amplitude increase in atmospheric CO₂ concentration at Mauna Loa, Hawaii, 1959-1982*. 1985. *Journal of Geophysical Research* 90, 10529-10540.

³ Houghton, J.T. and Ding, Y. et al. IPCC: Working Group I. *Climate Change 2001: The Scientific Basis*. 2001. Cambridge University Press.

⁴ Hubbert, Dr. M. King. *Energy from Fossil Fuels*. Feb. 1949. *Science*, Vol. 109, No. 2823. American Association for the Advancement of Science.

⁵ DTI/Defra. *Energy White Paper, A Summary: Our energy future - creating a low carbon economy*. 2003. DTI publications online.

⁶ Marland, Boden & Andes. *Global, Regional, and National Fossil Fuel CO₂ Emissions* Carbon Dioxide Information Analysis Center, U.S. Department of Energy. http://cdiac.esd.ornl.gov/trends/emis/meth_reg.htm

⁷ MtC = million metric tonnes of carbon. tC = metric tonnes of carbon

⁸ DTI/National Statistics: Businesses <http://www.statistics.gov.uk/ccinugget.asp?id=1238> [August 2007]

40% of all non-transport energy and space heating/hot water, 64% of commercial energy in 2000⁹.

The UK government has been introducing legislation to reduce emissions such as the changes to Approved document L, the document in support of the Building Regulations concerned with the conservation of fuel and power. It has also introduced the climate change levy on all fuel bills to commercial businesses which is currently set at 0.43pence per kWh for electricity and 0.15pence per kWh for gas according to the case study fuel bill information.

Water resources vary with environmental conditions. The recent drought conditions experienced in parts of the UK between 2004 and 2006 have brought to the government's attention the need to conserve water supplies and use them efficiently. In 2006 the government departments of Communities and Local Government and DEFRA issued a consultation document setting out the case for adding water efficiency to the Building Regulations.¹⁰ The proposal is to give water consumption limits for the design of new buildings dependent on their intended use. The report states that the UK uses 15000 megalitres of water a day of which one third is used to flush toilets.

The use of landfill sites to dispose of waste creates pollution, uses up valuable land and is not an efficient use of the materials disposed of. In November 2002 the Cabinet Strategy Unit issued a report proposing a strategy for waste issues in England.¹¹ This led to the replacement of planning guidance 10 with the 2005 Planning Policy Statement 10 which gives the national policy on waste which is used to create the individual planning policies of all the regional planning authorities. It calls for measures to minimise landfill waste using the 'Minimise, reuse, recycle, dispose' principle.¹² According to national statistics online figures for 2002-3 the UK produce 330.4Mt of commercial waste of which approximately 64% goes to landfill. This equates to about 20 tonnes of waste to landfill per VAT-registered business.

Products use natural resources including energy in their extraction, manufacture, distribution, use and disposal. The waste section in the previous paragraph is concerned with extending the time in use. The Carbon Trust is working on ways to reduce energy consumption in the supply chain, the part of a product's life between extraction and point of use. This energy, known as the 'embodied energy', of a package of crisps and a newspaper are used as examples in their publication, '*Carbon Footprints in the supply chain*'¹³ which show that significant reductions can be made by quantifying each stage. The Trust is also working with industry to produce an embodied energy label which will give the carbon emissions associated with a product in grams of carbon. Energy is not the only environmental issue related to products and there are myriad of environmental labels being used, as can be seen

⁹ DTI/National Statistics: *Energy Consumption in the United Kingdom: 2001*. DTI

¹⁰ CLG/DEFRA *Water Efficiency in new buildings: A consultation document*. 2006. CLG.

<http://www.communities.gov.uk/publications/planningandbuilding/mandatingwaterefficiency>

¹¹ Cabinet Strategy Unit. *Waste not, Want not: A strategy for tackling the waste problem in England*. Nov. 2002.

http://www.cabinetoffice.gov.uk/strategy/work_areas/waste/index.asp

¹² ODPM: *PPS10: Planning for Sustainable Waste Management*. July 2005.

¹³ Carbon Trust. *Carbon footprints in the supply chain: the next step for business*. Nov. 2006.

<http://www.carbontrust.co.uk/publications/publicationdetail?productid=CTC616>

in the DEFRA pamphlet 'A shopper's guide to green labels'¹⁴, but no one is comprehensive or comprehensively used.

Background to the Standard

In 1946 a group of like-minded individuals met at a conference held in London. As a result the International Organization for Standardization,¹⁵ the organisation responsible for ISO 14001, was founded on 23 February 1947, setting up its base in Geneva, Switzerland where it remains to this day. Originally composed of national standards bodies from 25 countries, it is now a federation of standards bodies from 157 countries with 3000 active technical groups and drawing on the expertise of around 50,000 people. It calls itself a non-governmental organization but in practice works as a consortium with strong links to government.

ISO 14001 is part of a series of environmental management standards developed by the International Organization for Standardization (ISO)¹⁶ largely in response to the Uruguay round of GATT (General agreement on tariffs and trade) negotiations and the Rio Summit in 1992.

The Rio summit and subsequent declaration on environment and development set the scene globally by requiring signatories to share knowledge to protect and improve the environment, carry out environmental impact analysis on activities and develop environmental standards.

At around the same time, the Uruguay Round of GATT negotiations started in response to the USA's decision to ban imports of Mexican tuna, on the grounds that their fishing methods, involving the death of dolphins, contravened the agreement. Countries, particularly developing countries, protested that trade restrictions relating to environmental standards amounted to 'green' protectionism but the negotiations revealed that they were more receptive to trade restrictions based on international environmental agreements such as the Montreal Protocol on ozone-depleting substances.¹⁷

In 1991 ISO set up the Strategic Advisory Group on the Environment (SAGE) to consider whether such standards could promote a common approach to environmental management, enhance and measure an organization's environmental performance and facilitate fair trade without barriers. National environmental standards began to be developed, the first being the UK standard BS7750 in 1992. This was withdrawn on the arrival of ISO 14001. As national standards began to merge, ISO set up Technical Committee 207, (TC207), which is responsible for the development of the 14000 series of standards. The first edition of ISO 14001 came out in 1996.

The ISO 14000 family:

- 14001 Development and implementation of environmental management systems (EMS)
- 14004 General principles of environmental auditing (Sister document to 14001)

¹⁴ DEFRA. A Shopper's Guide to Green Labels: Understanding environmental labels on products. <http://www.defra.gov.uk/environment/consumerprod/glc/index.htm>

¹⁵ International organisation for standardisation. Press releases and ISO surveys. <http://www.iso.org/iso/en/ISOOnline.frontpage> [August 2007]

¹⁶ International Organisation for Standardisation. <http://www.iso.org/> [August 2007]

¹⁷ Cough, P. 1993. *Trade-Environment tensions: Options exist for reconciling trade and environment*. EPA Journal 19 (2): 28-32.

- 19011 (Supersedes 14010 to 12) Guidance for auditors.
- 14013/15 Audit programme review and assessment material
- 14020+ Environmental labelling issues
- 14030+ Performance targeting and monitoring in EMS.
- 14040+ Life cycle issues

The standard was revised to its current edition in 2004. The revisions were intended to simplify the language to be more 'user-friendly' to small and medium sized businesses and to make it more compatible with the quality assurance standard ISO 9001 by using common language and methodology. The ISO 9001 standard is produced by the same organisation. It also sets out the requirements for a management system but, instead of the reduction of environmental impacts, it is concerned with the quality of commercial outputs so as to meet a client's requirements and promote customer satisfaction.

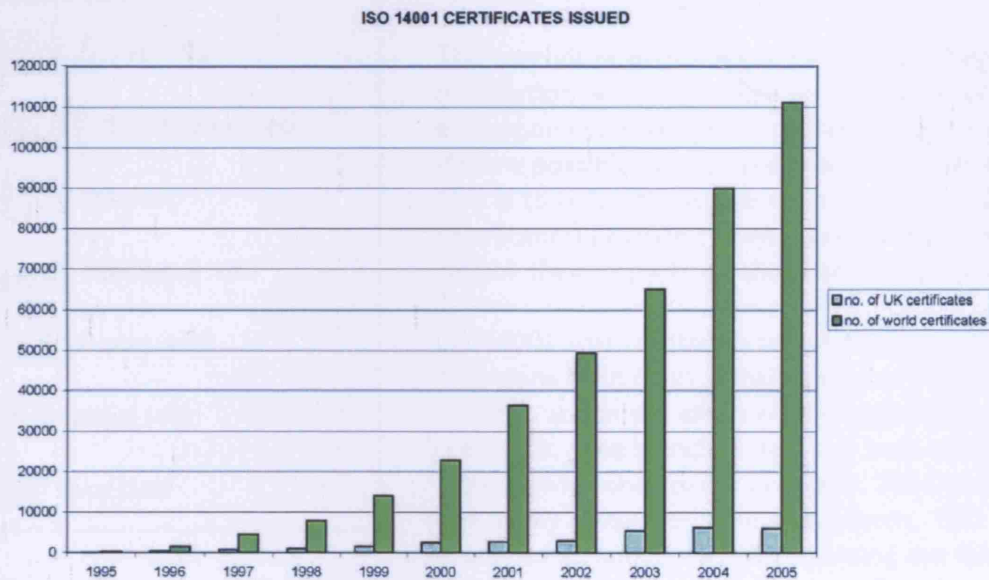


Fig. 1: Graph showing UK and World ISO14001 certificate numbers since 1995. source: ISO Survey 2005¹⁸

When ISO's international standards are published, they are adopted by the national standards body in each individual country and translated. In the UK the national standard body is the British Standards Institute, (BSI)¹⁹.

ISO carries out an annual survey of all ISO14001 certificates across the world²⁰. It shows a steady increase in take-up, both in this country and across the world, since the launch of the draft version in 1995. The 2006 results are not quite out yet but based on the 2005 report, the UK has 6055 accredited organizations compared with 11,112 worldwide in 138 countries. In numbers the UK is ranked 5th, surpassed by Japan, China, Spain and Italy respectively.

The UK was one of the initial reviewing nations of the draft 1996 version of ISO 14001 and started well with 22% of the total take up of certificates in the first year. Since then take up

¹⁸ Press releases and ISO surveys. <http://www.iso.org/iso/en/ISOOnline.frontpage> [August 2007]

¹⁹ British Standards Institute. <http://www.bsi-global.com/> [August 2007]

²⁰ Press releases and ISO surveys. <http://www.iso.org/iso/en/ISOOnline.frontpage> [August 2007]

has steadily increased but not at the same rate as other countries like Japan and China. Italy and Spain have roughly the same size population as the UK and yet have more certificates. A comparison of the number of certificates with the number of VAT-registered businesses in the UK shows a take up of 0.4%.



Fig. 2: Graph showing top ten countries certificates in 2005. source: ISO Survey 2005²¹

The current environmental issues at the beginning of this section are intended to give a flavour of what an environmental management system might embrace. Where possible, figures are given to show scale. This is to help answer the question: does ISO 14001 certification provide a useful way for businesses to reduce their impacts on these and other such issues?

ISO 14001 was created in an atmosphere of good intentions both from global events at the time of its creation and in the ethos of the organisation which created it. The standard has now been around for 11 years with one recent update in 2004 and is part of a family of environmental standards. ISO produces an annual report recording the take-up of

certified organisations. The 2005 survey shows the UK as one of the top five countries in take-up number but this still only represents 0.4% of VAT-registered businesses. This report will look for reasons why businesses might not choose to implement and use the standard.

The next section looks at the standard in detail to find out what the environmental management system is. Interviews are used to show how the standard is used in practice.

²¹ Press releases and ISO surveys. <http://www.iso.org/iso/en/ISOOnline.frontpage> [August 2007]

PART 2: THE ISO14001 STANDARD

This section of the report looks in detail at the standard itself. It comprises a set of requirements for setting up an environmental management system, a glossary of terms used, some guidance for use and a table showing the corresponding clauses between ISO14001 & ISO9001.

The requirements can be summarised thus. An organisation shall have the following:

- An environmental Policy.
- A Register of environmental aspects.
- A procedure to identify legal and other requirements and determine how they apply to the aspects. Keep records.
- A set of objectives and targets. Programme and keep records.
- A senior manager and appropriate other resources to manage the environmental management system. Keep records.
- Set environmental management system scope, framework and procedures. Document.
- Provided adequate training and shown competence to perform tasks. Retain associated records.
- A procedure for internal communication and optional procedure for external communication to interested parties.
- An approval process for documentation prior to issue. Clearly identify documents and versions.
- Procedures and requirements for the procurement of goods and services
- Emergency response plan and periodic testing
- Monitoring and measurement of key aspects which have significant environmental impact.
- A procedure for identifying conformity and rectifying non-conformity. Keep records.
- Internal audits at planned intervals. Keep records.
- Top management reviews at planned intervals. Keep records.²²

These requirements are set out in a little more details below. With the exception of Certification, the titles used are the same as in the standard and in the same order.

Certification

ISO 14001 is the only one of the ISO 14000 family which can be certified by a third party but it is not necessary to be certified. Conformity, according to clause 1c of the standard can be demonstrated in four ways:

- Self determination and self declaration
- Seeking confirmation of conformance from interested parties such as clients
- Seeking confirmation of conformance from an external party
- Seeking certification/registration by an external organisation.

ISO does not provide certification of its standard. This is done at national level. Anyone can confirm compliance but only those accredited by the United Kingdom Accreditation

²² British Standards Institute: *BS EN ISO 14001: 2004: Environmental management systems - Requirements with guidance for use.* BSI

Service, (UKAS)²³, can provide certification and registration in this country. Each accredited auditor is issued a certificate which is posted on the UKAS website. This states which type of organisation and in which countries the holder is qualified for. Architecture is not mentioned specifically but is covered under 'Construction' according to Alan Brock at the British Standards Institute.

Policy

The policy is the statement of intention upon which the environment management system of an organisation depends. There needs to be sufficient detail in the policy to show what compliance entails. The standard under clause 4.2 requires that:

"Top management shall define the organisation's environmental policy and ensure that, within the defined scope of its environmental management system, it

- a) is appropriate to the nature, scale and environmental impacts of its activities, products and services,*
- b) includes a commitment to continual improvement and prevention of pollution,*
- c) includes a commitment to comply with applicable legal requirements and with other requirements to which the organisation subscribes which relate to its environmental aspects,*
- d) provides the framework for setting and reviewing environmental objectives and targets,*
- e) is documented, implemented and maintained,*
- f) is communicated to all persons working for or on behalf of the organisation, and*
- g) is available to the public."*²⁴

Planning

Clause 4.3 covers the requirements relating to:

- environmental aspects,
- legal and other requirements,
- objectives and targets.

These three elements comprise what is managed by the environmental management system.

Environmental Aspects

Environmental aspects are defined in the standard as the elements of an organisation's activities, products or services that can interact with the environment and a significant aspect is one that has a significant environmental impact.

The standard does not list any aspects in the requirements, but asks for a procedure for identifying them, good or bad, and then identifying which ones are significant. This allows the aspects to be revised as the organisation changes over time. All the aspects need to be documented and kept up to date and the significant ones monitored and measured so that objectives can be set for their mitigation.

There is some advice about choosing aspects in the guidance in Annex 3 of the standard itself and in ISO 14004 which also has some examples in table A.1.²⁵ The guidance gives the following list of aspects as a possible approach:

²³ UKAS. Accredited certifiers list.

http://www.ukas.com/about_accreditation/accredited_bodies/certification_body_schedules.asp [August 2007]

²⁴ British Standards Institute: BS EN ISO 14001: 2004: Environmental management systems - Requirements with guidance for use. BSI

²⁵ British Standards Institute: BS ISO 14004: 2004: Environmental management systems - General guidelines on principles systems and support techniques. BSI

- “emissions/releases to air, land and water
- use of raw materials and natural resources
- use of energy,
- energy emitted, eg. heat, radiation, vibration,
- waste and by-products, and
- physical attributes, eg size, shape, colour, appearance”

It also gives a list of possible activities, products and services which might contain aspects:

- “design and development,
- manufacturing processes,
- packaging and transportation,
- environmental performance and practices of contractors and suppliers,
- waste management,
- extraction and distribution of raw materials and natural resources,
- distribution, use and end of life of products and
- wildlife and biodiversity.”

The guidance also suggests that an organisation identifies whether an aspect is something within the organisation’s control or influence as this will limit possible objectives and targets.

Legal and other requirements

There are a wide variety of environmental legislation and other requirements already in existence or being drafted. As with the aspects, the standard requires a procedure for identifying legal and other requirements and how they relate to the aspects. This puts the onus on the organisation to be up to date with requirements related to the environment and to the specific nature of the organisation, be they at local, national or international level. It also avoids the need to constantly update the standard to suit each new piece of legislation and allows the organisation some flexibility in how this is done.

Objectives and Targets

The objectives show what the aim is and the target shows how and when that aim is to be achieved. The standard requires a list of objectives and targets which need to be measurable where possible, be in line with the policy and in compliance with the legal and other requirement and to support continual improvement. They need to take into account the significant aspects and “consider its (the organisation’s) technological options, its financial, operational and business requirements and the views of interested parties.”²⁶ The standard also requires these to be programmed, setting the means and time-frame for achievement.

Implementation and operation

Clause 4.4 of the standard sets out the requirements for setting up the management system itself to ensure the managed items required by the previous clause are established, maintained, reviewed and continually improved by appropriately competent people, and recorded, stored and communicated correctly so that they can be easily followed by the whole organisation and reviewed and approved by the external auditor on a regular basis.

The standard requires that the system is managed by a senior manager who is responsible for reporting to top management. That person is required to provide appropriate staff numbers and skills to carry out the programme of objectives and targets in accordance with

²⁶ Clause 4.3.3. BS EN ISO 14001: 2004: Environmental management systems - Requirements with guidance for use. BSI

the system's policy and procedures. Skill needs to be demonstrated by training and competence records. The system manager is also responsible for communications necessary for the running of the system and staff awareness generally.

There needs to be a document control procedure in place to locate current information, and clearly display its function, status and version.

For hazardous impacts there needs to be a recorded and regularly tested procedure in case of accident.

Checking

To show improvement in the significant aspects and their objectives and targets, they need to be monitored and measured on a regular basis. Methods and equipment used for this must be verifiably accurate.

The standard requires the keeping of records in a managed way to show compliance with the legal and other requirements and conformance with system and its policy. Regular internal audits are required to monitor the whole system.

Management review

To comply with the standard the system, policy, objectives and targets need to be reviewed by top management on a regular basis and records taken. The reviews to include:

- Internal audit results and compliance with legal requirements
- Communications incl. complaints from external interested parties
- Environmental performance
- Extent of to which objectives and targets are met
- Status of corrective and preventive actions
- Previous review actions
- Changing circumstances incl. legal and other requirements
- Recommendations for improvement

Review information from two certified organisations

To get a better understanding of how these are implemented in practice a couple of interviews were made with organisations who have already attained ISO 14001 certification. The two certified companies interviewed are both large and international with over 10,000 employees, much larger than the AFR international workforce of approximately 200. They both, however, carry out building projects, though generally larger than AFR's and with a more engineering bias. Atkins²⁷ has full architectural design division. Examples of its projects include Burj Al Arab hotel, Dubai and Manchester metro link. Mott MacDonald²⁸ has worked on projects such as Wembley stadium; Rabi oilfield, Gabon; Cruach Mhor wind farm, Scotland; and terminal 5, Heathrow.

More companies were asked to give interviews and some effort was made to find smaller companies closer in size and nature to the case study without success. There are a few of the larger architects' practices, like YRM, currently seeking certification but have not yet attained it to date, August 2007. The source of this information was from the accredited auditors asked to quote for the case study but there were some issues of confidentiality which restricted the information.

²⁷ Atkins. <http://www.atkinsglobal.com/>

²⁸ Mott MacDonald. <http://www.mottmac.com/> [2007]

Certification

Atkins gained their first ISO14001 certificate in 2003 while Mott MacDonald set up their environmental management system in 1999 and received their first certificate in 2002. Both companies have fully upgraded to the 2004 version of the standard.

Both certified organisations chose to be ISO 14001 certified because of client pressure and as a marketing device to get more work. One stated that they also had significant pressure from within, particularly from their own environmental advisory team. They have certified their divisions individually and have over 60 certificates throughout the company. It is interesting to note that the other has an environmental management system throughout their organisation but has chosen only to certify those divisions for which there is a commercial advantage.

Policy

Neither of the interviewees identified any problems developing their own policies but it is interesting to note that one of them only has their policy available for public scrutiny by reading the copy posted in their main office and other is supposed to be available on their website but this could not be verified.

Environmental Aspects

Mott MacDonald has one common framework and policy across the whole organisation but individual aspects and requirements for each division. This allows them to be more closely tailored to each division's needs while keeping the overall goals and management system consistent across the whole organisation.

Legal and other requirements

Mott MacDonald identified this part of the standard as the most difficult to identify and verify especially in foreign countries. To resolve the problem they tend to employ a local partner, whether individual or company, to take on this role. In this country, they already had a basic list of legal and other requirements. The job of keeping it up to date and related to the aspects is the responsibility of their ISO14001 management team. Atkins have a full time dedicated 5person team whose job it is to track upcoming legislation and keep the organisation informed of the implications.

Objectives and Targets

Mott MacDonald sets annual objectives and targets while Atkins does so every six months in response to their external audits.

Implementation and operation

Both certified companies have a dedicated team to manage the system run by a senior manager.

Checking

Mott MacDonald has both leasehold and owned premises whereas Atkins offices are all leasehold. Both have trouble getting adequate energy data. Atkins is considering but has not yet approved, a request to all their landlords for individual metering at Atkins' cost.

That concludes the review of ISO14001 requirements and the interview information from two certified companies.

The policy is the main document which describes the organisations intentions, commitments and the framework for setting objectives and target. The system manages the organisation's environmental aspects, legal and other requirements and a programme of objectives and targets. The policy and aspects reflect the activities, products and services of the organisation. Once set appropriately, they should not need much changing, unless the nature of the business changes. Legal and other requirements will change over time and need regular review and work done to relate them to the organisation's aspects. Objectives are required to be set at regular intervals to ensure continued improvement. The rest of the requirements are about how to manage these so as to control and verify compliance.

Of interest, from the interviews, is how the companies chose to certify themselves, particularly Mott MacDonald's decision to have a common management system throughout the company but only to 3rd party certify the division for which there is a commercial advantage. This helps to keep costs and the amount of paperwork down. It is also interesting to note that both companies have problems with energy data collection in relation to their lease hold properties. This will come up again in the later casestudy audit section. First, Part 3 looks at how the casestudy organisation intends to implement ISO14001.

PART 3: IMPLEMENTATION OF ISO14001: A CASESTUDY

This part of the report looks at how Aukett Fitzroy Robinson have been working towards implementation of ISO14001. It starts with a section about the company and the two offices proposed for certification, followed by how the implementation is being managed. There follows a review of the work done to create the policy, set up the framework and procedures, with a look at how the legal and other requirements might be managed. Finally it looks at how the aspects themselves were identified, measured and objectives set.

The Casestudy: Aukett Fitzroy Robinson

Aukett Fitzroy Robinson is an international practice based in London but with branches in parts of the UK, the European Union, Eastern Europe and Russia. The case study only looks at implementation for the main London office in Devonshire Street and the overspill office in Regents Street, within walking distance of each other in the West End and with about 150 employees over the two sites. Both sites are leased accommodation. Figures 3-6 show the office layouts, including the survey work carried out for the company's first office activities audit described in Part 4. The organisation is divided into different sectors based on building types: Offices, Interiors, Retail, Hotels, Residential, Transport and Landscape and well as the administration, accounts and graphics departments.

Devonshire Street has 1325m² of treated floor area,²⁹ of which the top two floors are designated under planning rules as residential and used occasionally for meetings. The treated area less the is reduced to 955m². Occupancy on the day surveyed was 73. Regent Street has a treated floor area of 608m² and a surveyed occupancy of 83. For a brief description of the building fabric see Appendix I.

Setting up of the implementation committee

In order to facilitate implementation of ISO 14001 at AFR, a committee was set up to oversee the process. The Green Group was started in September 2006. It meets monthly with additional meetings when required. The remit of the committee is to improve on project sustainability, work towards ISO14001 certification, advise the appropriate AFR board of requirements and seek approval. There were 6 original members of the group and one additional member since, making 7 in all. They are all architects from different design sectors of the practice, including the design director and the author of this report, who is responsible for delivering ISO 14001 certification. The director of overseas and one of the joint managing directors for UK operations are also honorary members who attend when they are available.

Certification

AFR is seeking certification both due to client pressure and from aspirations within, to design buildings with better environmental credentials. Many of their past projects have significant sustainable elements to them but the hope is that an environmental management system will give a more holistic approach to a project as well as be seen as such. The Green Group, have gone to three auditors for quotations: Lloyds Register Quality Assurance (LRQA)³⁰, auditor for AFR's ISO9001 certification, BSI³¹ and BRE³². All three were chosen because they are accredited by UKAS, their certificates all include construction and they have accreditation in a wide selection of other countries, particularly those where AFR have

²⁹ Treated floor area is area net of stores and plant rooms as described in ECON19.

³⁰ LRQA: <http://www.lrqa.co.uk/>

³¹ BSI: <http://www.bsi-global.com/>

³² BRE: <http://www.brecertification.co.uk/page.jsp?id=5>

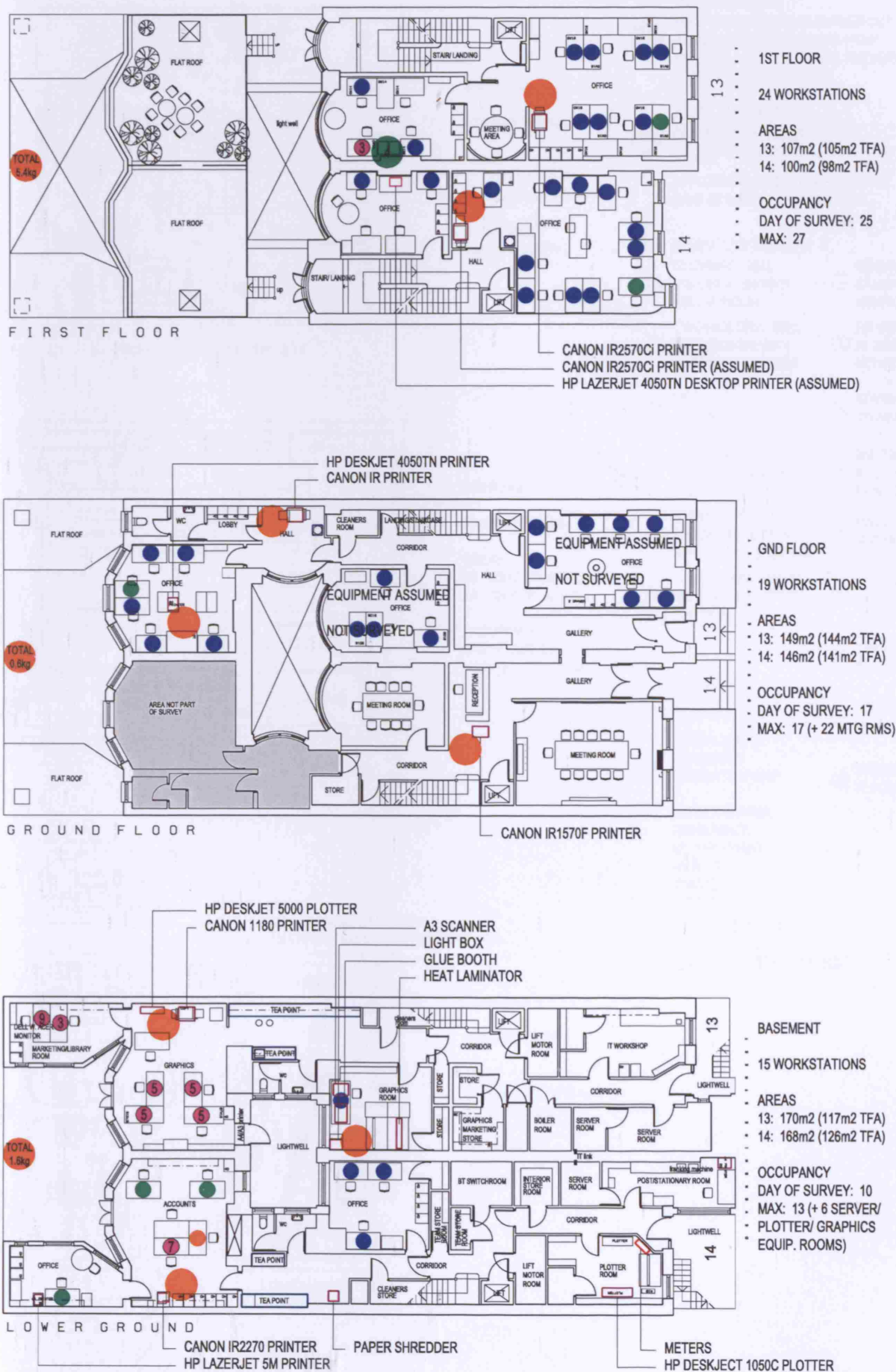
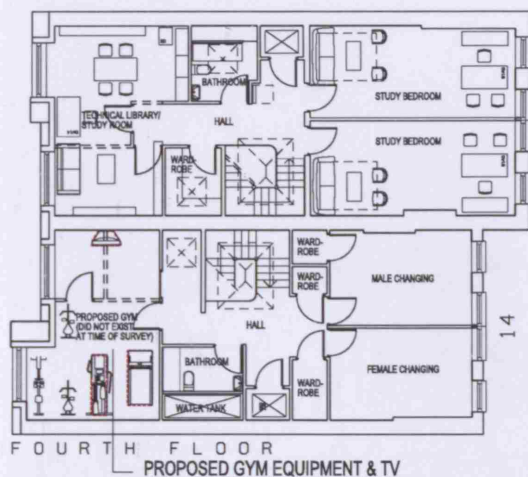


Fig. 03: Devonshire St. Basement to 1st floor plans showing survey work



4TH FLOOR

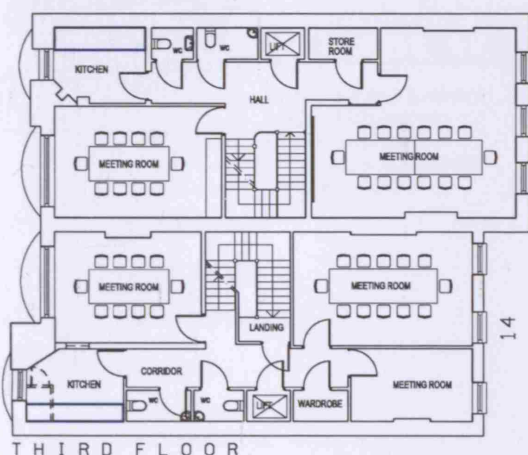
0 WORKSTATIONS

AREAS

13: 102m² (95m² TFA)
14: 93m² (86m² TFA)

OCCUPANCY

DAY OF SURVEY: 0



3RD FLOOR

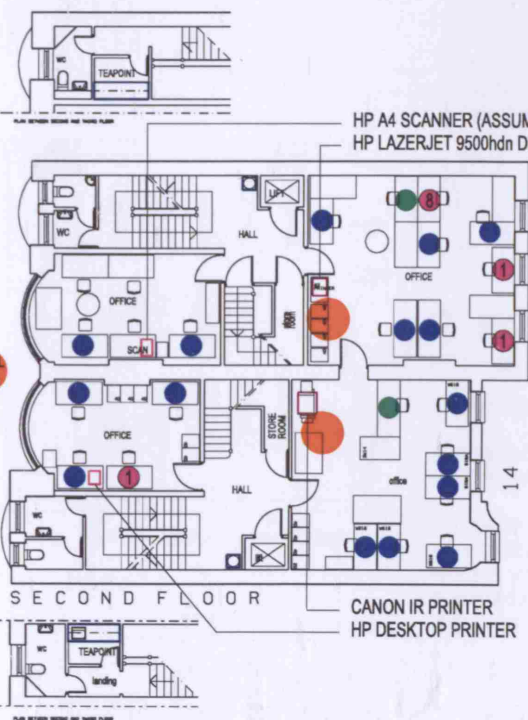
0 WORKSTATIONS

AREAS

13: 103m² (98m² TFA)
14: 95m² (91m² TFA)

OCCUPANCY

DAY OF SURVEY: 0
MAX: (20 - 52 MTG RMS)



2ND FLOOR

22 WORKSTATIONS

AREAS

13: 107m² (102m² TFA)
14: 99m² (95m² TFA)

OCCUPANCY

DAY OF SURVEY: 21
MAX: 27

HOB0 MONITORING

HOB0 MONITORING WAS CARRIED OUT IN 3NO. INTERNAL LOCATIONS & ONE EXTERNAL LOCATION DURING THE WEEK 27TH JULY TO 3RD AUGUST

WASTE PAPER SURVEY

DEVONSHIRE ST: 5/6/07
REGENCY ST: 24/5/07

APPLIANCE SURVEYS TAKEN ON SAME DAYS AS WASTE PAPER SURVEYS

COMPUTERS/ MONITORS

STANDARD: DELL

PRECISION 380 WITH DELL MONITOR

GRAPHICS CPU: DELL
PRECISION 690 WITH HIGH SPEC. MONITOR

DELL LAPTOP

COMPACT DELL WITH ULTRA-SHARP MONITOR

STANDARD DELL PRECISION 380 WITH ULTRA-SHARP MONITOR

OTHER COMPUTER OR MONITOR. SEE NOTES FOR TYPE

① RM COMPUTER W. STANDARD DELL MONITOR

② RM HIGH SPEC. CPU W. STANDARD DELL MONITOR

③ STANDARD DELL W. IYAMA MONITOR

④ RM COMPUTER WITH ULTRA-SHARP MONITOR

⑤ MAC G4 OR G5 WITH MAC MONITOR

⑥ ACER W. DELL MONITOR

⑦ UNIDENTIFIED CPU W. PHILIPS MONITOR

⑧ ACER W. IYAMA MONITOR

⑨ STANDARD DELL W. ACER MONITOR

TEAPOINTS

TEA POINT

TYPICAL LIST OF APPLIANCES IN EACH TEAPOINT:

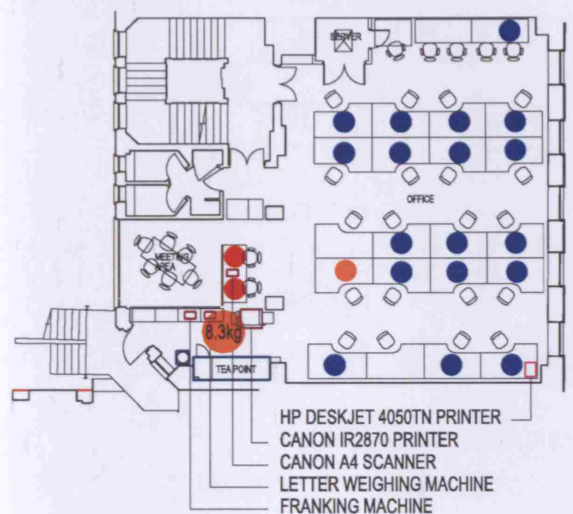
REFRIGERATOR
DISHWASHER
COFFEE MAKER
MICROWAVE
TOASTER
KETTLE

☒ WATER COOLER

PRINTERS/ OTHER APPLIANCES

☐ ☐

Fig. 04: Devonsire St. 2nd to 4th floor plans showing survey work

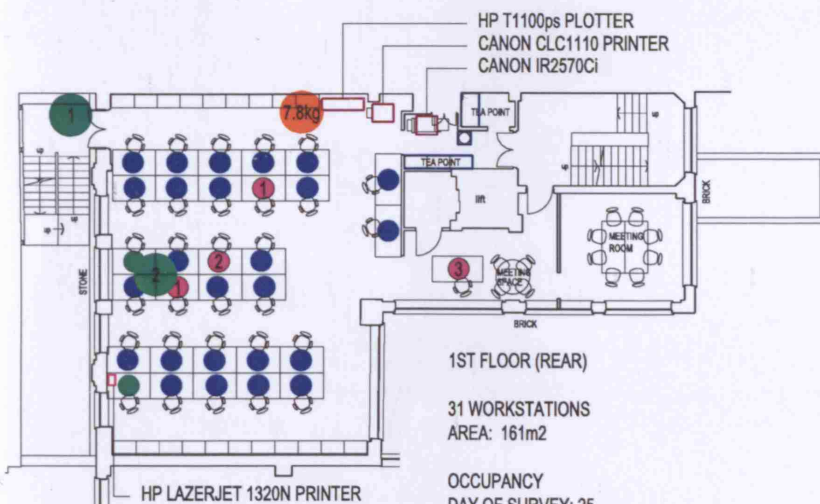


1ST FLOOR (FRONT)

20 WORKSTATIONS
4 TOUCHDOWN
2 GRAPHICS STATIONS

AREA: 148m²

OCCUPANCY
DAY OF SURVEY: 13
MAX: 24 (+ 6 MTG SPACE)



1ST FLOOR (REAR)

31 WORKSTATIONS
AREA: 161m²

OCCUPANCY
DAY OF SURVEY: 25
MAX: 31 (+12 MTG SPACES)
DURING HOBO WEEK: 28

HOBO MONITORING

HOBO MONITORING WAS CARRIED OUT
IN 3NO. INTERNAL LOCATIONS & ONE
EXTERNAL LOCATION DURING THE WEEK
27TH JULY TO 3RD AUGUST

WASTE PAPER SURVEY

DEVONSHIRE ST: 5/6/07
REGENT ST: 24/5/07

APPLIANCE SURVEYS TAKEN ON SAME
DAYS AS WASTE PAPER SURVEYS

COMPUTERS/ MONITORS

STANDARD: DELL
PRECISION 380 WITH
DELL MONITOR

GRAPHICS CPU: DELL
PRECISION 690 WITH
HIGH SPEC. MONITOR

DELL
LAPTOP

COMPACT DELL
WITH ULTRA-SHARP
MONITOR

STANDARD DELL
PRECISION 380 WITH
ULTRA-SHARP MONITOR

OTHER COMPUTER OR
MONITOR. SEE NOTES
FOR TYPE

① RM COMPUTER W.
STANDARD DELL
MONITOR

② RM HIGH SPEC. CPU
W. STANDARD DELL
MONITOR

③ STANDARD DELL W.
IIYAMA MONITOR

④ RM COMPUTER
WITH ULTRA-SHARP
MONITOR

⑤ MAC G4 OR G5 WITH
MAC MONITOR

⑥ ACER W. DELL
MONITOR

⑦ UNIDENTIFIED CPU
W. PHILIPS MONITOR

⑧ ACER W. IIYAMA
MONITOR

⑨ STANDARD DELL
W. ACER MONITOR

TEAPOINTS

TEA POINT

TYPICAL LIST OF
APPLIANCES
IN EACH TEAPOINT:

REFRIDGERATOR
DISHWASHER
COFFEE MAKER
MICROWAVE
TOASTER
KETTLE

☐ WATER COOLER

PRINTERS/ OTHER APPLIANCES

☐ ☐

Fig. 05: Regent St. 1st floor plans showing survey work

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●

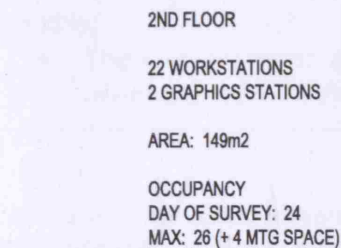
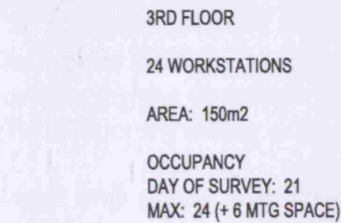


Fig. 06: Regent St. 2nd & 3rd floor plans showing survey work

other branches. Their accreditation certificates can be found on the UKAS website³³.

AFR's activities do not vary significantly from one branch to another so it is likely, when the London environmental management system is successfully up and running, that the system will be rolled out to all the other branches of the organisation. Whether they all get certified is a commercial decision for senior management.

The quotes received are based on the number and type of office and the number of employees. There was some variation in prices, £4-5000 for the initial set up, including an optional advance gap analysis to identify any areas which might need improving before the actual certification audit. After certification there are continuing audits, usually every 6 months, to ensure the system is adequately maintained. This will cost AFR around £1-2000 per annum for the London offices, a significant ongoing commitment.

Policy

The first action of the AFR Green Group was to develop a policy. They started by looking at architects' and other similar organisations policies posted on their websites. Some of those looked at were MacCormac Jamieson Prichard, BDP, Kent County Council, Camden Borough Council. It was not known which, if any, of these had an ISO14001 certificate. The team did not have sufficient information at the time to write the policy and in December 2006 it was agreed to put a temporary policy in place and move on to considering the company 'aspects' with the intention of returning to the policy afterwards. The temporary policy does not comply with all of the standards requirements.

Legal and other requirements

Many existing legal and other requirements are already followed by AFR in the course of their work. Each member of technical staff has access to Technical index online³⁴ and specification writers have access to 'NBS Building'³⁵. Technical indexes online gives access to building related standards, the Building Regulations Approved Documents. 'NBS Building' is a program which helps a specifier write National Building Specification style specifications which references to all the relevant standards and legislation. Neither are specifically aimed at environmental issues. The suggestion of Alan Brock at BSI is to use the Environment Agency website to monitor all new environmental legislation. AFR currently intend to review this website monthly and delegate the review of new requirements as part of the committee's monthly meetings.

Framework

The policy, aspects, requirements and framework are intended to be kept in a document called the 'Green Manual', intended to be reviewed annually both externally and by top management along with the annual office audit, project and training progress and the progress of the EMS committee. A member of senior management will manage the environmental management system (EMS) with the help of the EMS committee as required by the standard. The determination, of who will be that person and who members the committee, is yet to be agreed. The EMS committee will review and manage the following monthly:

- The requirements: to ensure they are up to date and someone is responsible for reviewing any new requirement.

³³ UKAS list of accredited auditors:

http://www.ukas.com/about_accreditation/accredited_bodies/certification_body_schedules.asp

³⁴ Technical Indexes Online: <http://www.tionestop.com/precis/refdocs/refdoctop.shtm>

³⁵ National Building Specification: NBS Building <http://www.thenbs.com/products/nbsBuilding/default.asp>

- Office objectives and targets: to ensure they are on track
- New projects: to ensure objectives and targets are being set & appropriate design reviews are being held.
- Training requirements: to ensure they are up to date
- Preferred and exempt supplies list: to ensure it is being managed adequately.

They will also put together the annual audit with recommendations for the following year's objectives and targets for board approval and external review and will also be responsible for seeing that all records are available for the 6month or interim external review. The results of the review will be reported to top management. The preferred and exempt supplies list needs a little explanation. This is one of the required procedures. An office cannot wait a few weeks or months to buy items, such as lavatory paper, and yet it is worth researching an environmentally appropriate type or source. The list will contain those items already reviewed and approved, state which products must be reviewed before purchase, any pollutants that should be avoided and those products which are exempt from review. In the beginning it is likely that many items will be exempt as there will be insufficient time to review them but it is hoped in a few years this will be reduced to none. Objectives and targets are set specifically for each project and are reviewed at planned intervals based on RIBA job stages³⁶ using the pre-existing Design Review system which is already used to comply with the ISO9001 quality standard.

Aspects

To tackle the identifying of aspects, it was decided to start with existing knowledge within the group and use the gap analysis to fill in any aspects missed.

AFR's aspects can divided into those related to the offices' activities and those its design projects. For both these areas, the significant aspects have been divided into five categories:

- Energy
- Water
- Waste
- Supplies (office) or Specification (projects) and
- Community.

This list has changed a lot over the last year. The original list was for project work only and came from analysis of '*The Green Guide to the Architects Job Book*'³⁷, '*The Rough Guide to Sustainability*'³⁸ and the list items gaining points using the '*BRE Environmental Assessment Method*', (BREEAM)³⁹. It was much longer but as this made many items irrelevant to some projects and the Design Review form difficult to cover in one meeting. It was decided to make the list as short as possible to be expanded uniquely for each project with specific objectives and targets. It also meant that the same overall list could be used for the office activities as well.

Having developed a rough list of aspects, AFR needed to ascertain which were significant and how they might be improved. It was decided to carry out an exploratory audit of the office activities to gage what sort of data could be gathered, how it might be benchmarked

³⁶ RIBA Plan of Work. <http://www.pedr.co.uk/textpage.asp?menu=1a&sortorder=130&area=main> . Note the plan of work was updated in July 2007 and due for publication shortly.

³⁷ Anderson, J. and Shiers, D. *The Green Guide to Specification*. Jan. 2002. Copyright Consignia, Oxford Brookes University and BRE. Published Blackwell Science Ltd.

³⁸ Edwards, B. with Hyett, P. *Rough Guide to Sustainability*. 2002. RIBA publications.

³⁹ BREEAM. <http://www.breeam.org/>

and how the available information might be used to set objectives and targets. The preliminary list of AFR's aspects is shown in table 2 which also gives the extent to which AFR has control over them.

TABLE SHOWING AFR 'ASPECTS' AND AFR CONTROL OVER THEM

ASPECTS	OFFICE ACTIVITIES	PROJECT WORK (Typical: Will vary between projects)
ENERGY		
1 Building Energy		
• Space heating, cooling & ventilation	Gas boiler Devonshire Street: Minor influence over choice, control over use.	Orientation, size, shape & location of building & specification of external envelope: major influence
• Hot water	Gas boiler Regent Street: Minor influence.	Choice of energy sources: influence. Choice of HVAC systems and controls: influence.
• Appliances	Control	Influence
• Lighting	Devonshire Street: partial control Regent Street: Minor influence.	Influence.
2 Transport energy		
(transport & other energy due to products is covered under supplies.)	Transport due to work: control Staff transport to and from work: influence.	Incentives to reduce high fossil fuel using transport: influence
WATER		
	Toilets: Partial control ex Regent S 1st Rear shared toilets Sinks & basins: Partial control Dishwashers: control	Water systems: influence
WASTE		
	Control	Waste facilities: Major Influence
SUPPLIES/SPECIFICATION		
	Supplies chosen: Control	Specification chosen: Major influence
COMMUNITY		
1 Health, happiness & Awareness of environmental issues	Staff happiness: influence Staff health: influence Staff awareness: influence Neighbourhood health, happiness & awareness: minor influence	Minor influence
2 Biodiversity & wildlife	Office biodiversity & wildlife: Partial control Neighbourhood biodiversity & wildlife: minor influence	Influence

Table 1: List of AFR's 'Aspects' showing the extent of control they have over them.

The development of AFR's environmental management system has been slow due to insufficient resources both in time and skill. All the members of the Green Group work full-time on projects which leaves little time to develop the system. It would also have been useful to have included representation from the administration, IT and accounts departments for advice on the office activities they control.

Identifying AFR's aspects was not an easy process and required quite a lot of knowledge on environmental issues. There is information available but it would be hard to find without knowing where to look. This could be provided by external expertise, like that provided by the accredited auditor, but this would incur costs.

Using table 2, a series of surveys were carried out to try to quantify the aspects related to office activities. There was insufficient data available for office related transport energy, the community section and project related aspects. The results of the survey work are given in Part 4.

PART 4: RESULTS OF AUKETT FITZROY ROBINSON'S 2006 AUDIT

This section shows the survey work undertaken and results calculated to demonstrate the significance of the AFR aspects identified to date and to help set objectives and targets for the coming year and beyond.

For aspects involving energy, the survey looked at fuel bills for total energy consumption for 2006, monitored appliances for their energy consumption and took some temperature and relative humidity readings in key areas to give some idea of comfort levels within the offices. Transport energy was not considered in this audit but a method for measurement in future audits is given. For water, water bills were used to give total water consumption for the year. For waste a sample survey of a day's waste paper was taken in each office. Other types of waste were not covered in this audit but are intended to be covered in the future. For supplies invoices were collected for one month to see the range of products bought. There was no data taken for the community aspects but some examples are given to show the scope and how aspects in this section might be measured in future.

Energy

Fuel bills to show total delivered energy consumption. Energy in buildings is used to provide comfort conditions over and above that provided by the fabric of the building itself. This could be for heating, cooling or ventilation. In addition it provides building with hot water, lighting and appliances. For both Regent and Devonshire streets the gas bill covers heating and hot water. The electricity bill covers lighting and appliances but also some comfort regulation due to individual fans & heaters and Regent Street has manually operated air conditioning units and a small amount of mechanical ventilation to the deepest plan areas. To understand the energy usage due to appliances and to try to separate their energy from the lighting an energy monitor was used. Energy due to work related transport not measured in this audit as the data was not available.

Total energy due to fossil fuel using fuel bills

The total building energy for Aukett Fitzroy Robinson's London offices in 2006 is 479MWh, or 1723GJ. This resulted in estimated emissions of carbon of 45.9tC.

This does not mean much without comparison with a recognised benchmark. This report uses the methodology and figures⁴⁰ given in 'Energy consumption guide 19: Energy use in offices' document, (ECON19), which is a guide to energy consumption based on an extensive survey of offices, carried out in the 1990's. In the guide values are given in kilowatt hours per square metre and in kilograms of carbon and divided into four categories of offices. By looking at the descriptions of each category it can be seen that Devonshire Street falls into office type 1 as it is cellular and naturally ventilated. Regent Street falls into office type 2 as it is open plan and largely naturally ventilated.

As can be seen in Figure 7, Devonshire Street has energy levels higher than ECON19 typical values. The buildings used 253kWh/m² in 2006 as compared with a typical value of 220kWh/m² and a good practice value of 120. Devonshire St's energy consumption is 23% above typical and 126% above ECON 19's good practice figure.

⁴⁰ With the exception of the conversion factors from kilowatt hours of energy to emissions of carbon for which the more up to date Carbon Trust figures were used. Carbon Trust: *Conversion Factors*. 26 March 2007. http://www.carbontrust.co.uk/resource/conversion_factors/default.htm

In terms of emissions, Devonshire St emitted 21.9kgC as a result of its fuel consumption which is 48% above typical and 164% above good practice.

This report used conversion factors from the Carbon Trust as they are more recent and should take into account any changes in efficiency for delivered energy.

The bar chart in Figure 7 shows that energy due to the gas central heating (second column from left) is between the typical and good practice benchmark but the energy attributed to the electricity bills covering appliances and lighting are greater than the ECON19 typical figures. Devonshire Street does house the main servers for both offices which could not be measured separately and would contribute significantly to energy levels. Types 1 & 2 figures from ECON 19 do not give an allowance for a computer room. The lowest value for servers is given for a type 3 office: 14kWh/m².yr and the highest, for a type 4, gives 105kWh/m².yr. The value for 'other' energy is 106kWh/m².yr which might imply a figure somewhere between these two figures.

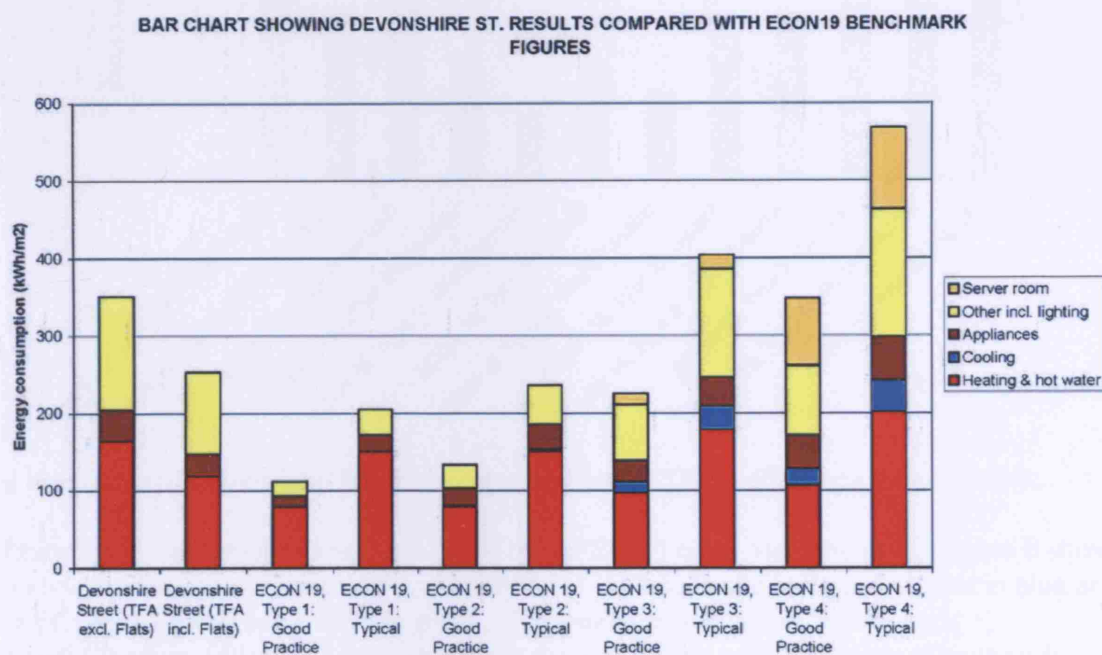


Fig. 7: Devonshire Street Fuel bill results compared with ECON19 office type 1 benchmarks.

Figure 7 shows two sets of figures for Devonshire Street. The left bar shows values with the flat areas excluded from the 'treated floor area'. This makes the energy and carbon emission per square meter much worse. These areas are not allowed to be used as office area under Westminster planning restrictions but are part of the heated volume. It would have been useful to have values per person in the ECON19 guide which would have avoided this issue.

There were no fuel bills available for Regent Street and the total energy results given, use the typical values given for offices type 2 in ECON19 for this building.

For Devonshire Street, gas bills covering all 12 months were used but both the first and the last values were estimates. The calculations for electricity energy were more complicated. There are four billed meters one for the office floors, basement to 2nd floor and one for the 3rd and 4th floors of the flat for both 13 and 14 Devonshire Street. Both office bills covered 12 months with some missing interim months for which readings could be worked out from

the meter readings of the months before and after. 14 Devonshire Street flat energy was based on readings covering 12 months but with the first reading an estimate and 13 Devonshire Street flat energy was calculated pro rata using 10 months of data.

BAR CHART SHOWING DEVONSHIRE ST. CARBON EMISSIONS FROM DELIVERED BUILDING ENERGY 2006

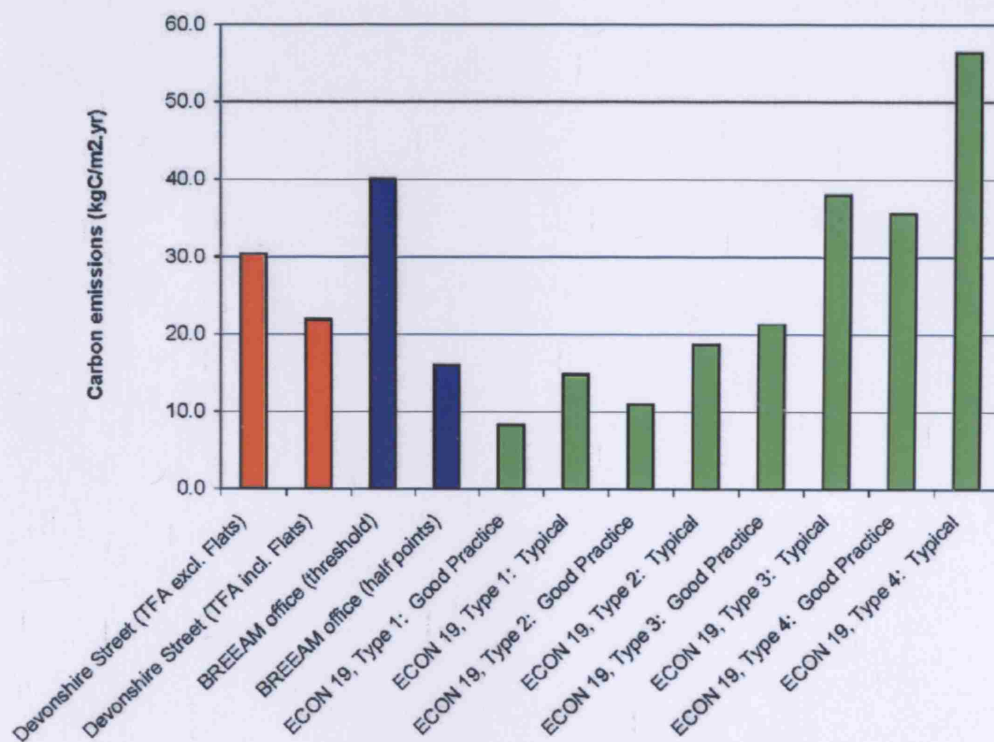


Fig. 8: Devonshire Street Fuel bill results compared with ECON19 office type 1 benchmarks.

Other useful benchmarks are those set in the BREEAM office assessments⁴¹. Figure 8 shows Devonshire Street consumption in red, BREEAM threshold and half points levels in blue and the ECON 19 levels are shown in green. The points threshold for emissions is 145kgCO₂/m².yr (40kgC/m².yr), higher than the AFR value, with half points allocation for 60kgCO₂/m².yr (16kgC/m².yr) and maximum points for zero emissions. This is useful as this assessment method is nationally recognised and AFR often use this assessment method to evaluate their project work.

To give an idea of how the buildings might be assisting in maintaining comfort for their occupants, temperature and relative humidity readings were taken in three office areas and one taken externally over a period of a week. This information was used to compare temperature inside the office areas with external temperature. Figures 9-11 show the results on graphs. The graphs use a fairly generous comfort zone of 18 to 27°C assuming minor changes in clothing, like the adding or removing of a jumper is acceptable.

The external temperature is moderated internally from both extremes, pushing the room into the comfort zone for all but two peaks on Friday and Sunday evenings. Note that everyone tends to leave on time on Fridays therefore the windows were shut earlier in the

⁴¹ BREEAM. <http://www.breeam.org/>

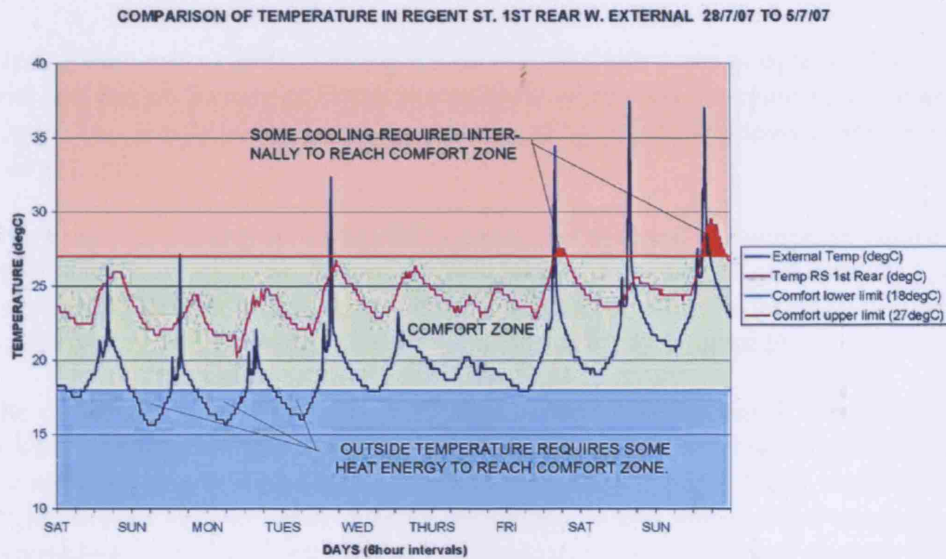


Fig. 9: Graph showing temperature in the first rear office, Regent St. compared with external.

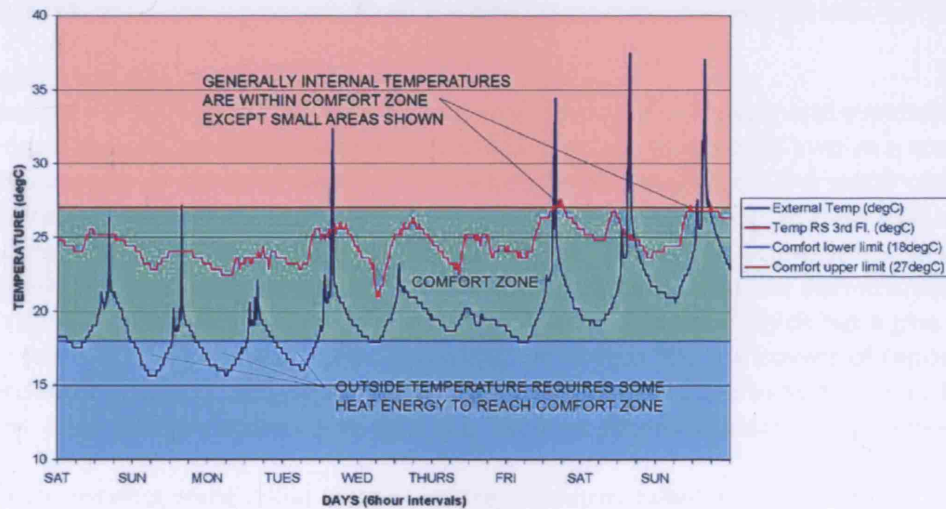


Fig. 10: Graph showing temperature in the third floor office, Regent St. compared with external.

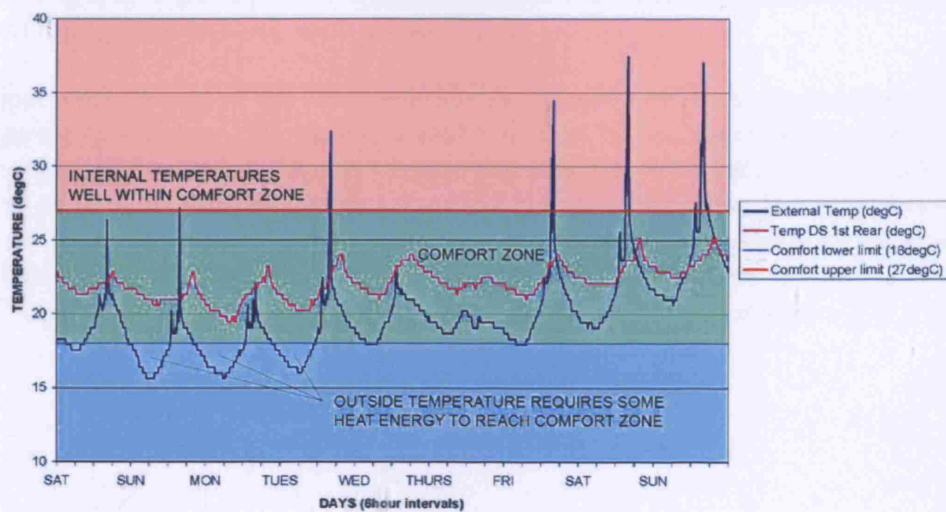


Fig. 11: Graph showing temperature in the first rear office, Devonshire St. compared with external.

evening than most nights. During the test week there were people working on Saturday until late but on Sunday as Friday the window were closed around 6pm rather than 9 or 10pm. This would indicate that the opening times of the windows might help to reduce energy costs.

There was no heating on during the week under test and the windows were open much of the day but it is unknown how much ventilation was provided and if any of it was mechanical. The air conditioner was not used. The windows face east and west and are double glazed and the west elevation was obscured by internal blinds most of the time.

The other two areas tested were 3rd floor in Regent Street and 1st rear in Devonshire Street. The internal temperatures in both these areas stayed within the comfort zone during office hours. The Devonshire Street room was north facing and single glazed which might account for the lower internal temperatures and single glazed windows with a more exposed east elevation and variation in occupancy, hence window opening times might account for the differences between figures 9 and 10. Computer modelling could be used to investigate further the heating and cooling usage of the two buildings but as AFR have little influence and no control over the heating systems, this will be kept for future years.

Energy use due to appliances

Each member of staff in the office has a workstation, a computer and monitor. The outputs from these are generally sent to a printer or plotter. Inputs may involve a scanner, photocopier or camera. During the day people get drinks from the water cooler or make coffee or tea using the coffee maker or kettle. Milk is kept cold in the fridge and some people use the toaster or microwave to heat up their lunch. Sometimes there are catered meetings. At the end of the day the cleaners load up and run the dishwashers. Post is weighed and franked and there is also a graphics department which has a glue booth and laminators for the preparation of presentation boards and the covers of reports. There are also large pieces of equipment, like the computer servers and individual ones like electric fans, blow heaters and vacuum cleaners. Neither office has electric hand dryers at present.

Measurements were taken using an energy monitor, called a 'Sparometer'⁴². As time was limited, appliances were first surveyed to get an idea of the scope of appliances. Devices were then divided into three categories: workstations, a typical teapoint and printing/scanning equipment. Appliances were then measured in order from the most common to the least for each group.

Most workstations in the office are type A, 126 units of 181 surveyed (shown in blue in figure 12), which is comprised of a Dell Precision 380 computer with a Dell flatscreen monitor. This workstation on a typical day uses 1.2kWh of electricity, produces 0.14kgC and costs 6p to use. By contrast the old RM computers, type F1, being phased out because their processing power is now too slow, uses about half the energy of the standard machine. The second bar shows the amount of energy used if the standard machine is left on standby all day: 0.12kWh; 0.01kgC and 1p ie about 10% of the energy in use.

⁴² Sparometer. <http://www.elsparefonden.org/consumer/products/energy-saving-equipment/sparometer>

BAR CHART SHOWING ESTIMATED ANNUAL CARBON EMISSIONS FOR THE MOST COMMON AUKETT FITZROY ROBINSON WORKSTATIONS

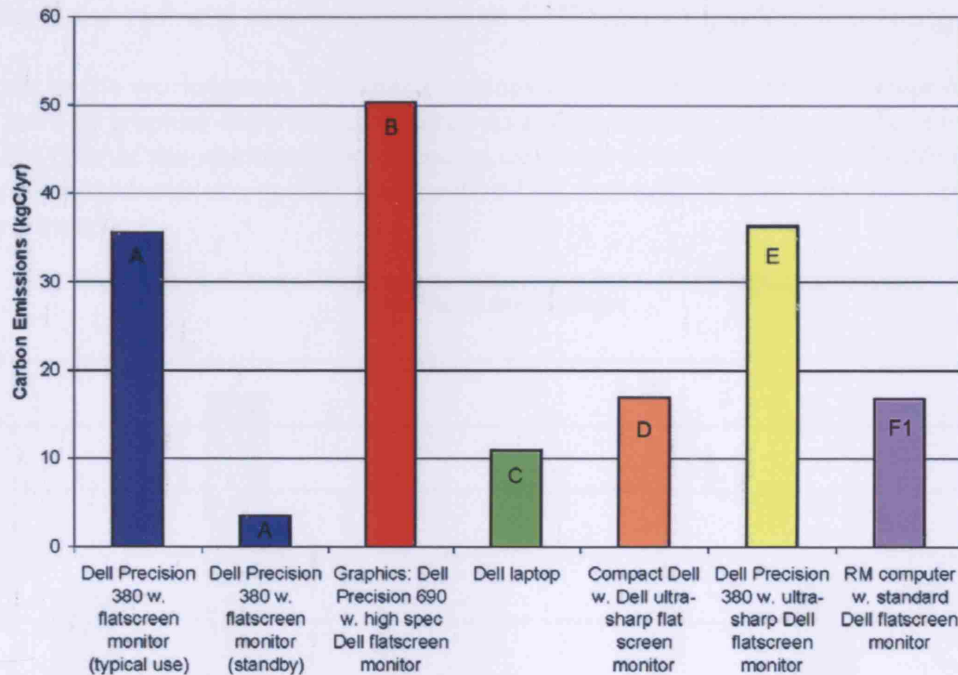


Fig. 12: Bar chart showing estimated annual carbon emissions for the most common workstations in AFR.

Other than the standard machine there are 3 other machines currently sanctioned for purchase. Types B and E are known as the Graphics machines. They are generally a higher specification and have various Graphics and other programmes intended for occasional use loaded onto them. There are generally 1-2 Graphics machines in each work area bought to cut down on the cost of software licences. This also cuts down on energy costs by reducing the number of high specification machines. The highest specification type B uses daily: 1.7kWh; 0.2kgC and 9p which is about 30% more energy than a standard machine.



Fig. 13: Bar chart showing energy consumption over 24 hours for monitors used at AFR.

The laptop, type C, uses surprisingly little energy despite having an integral monitor and bearing in mind the machine under test was used for almost a full 13hours, longer than the

normal working day of 7.25hrs. This can partly be accounted for by the fact they are not left on standby over night as they are generally taken home by their owners for security. The laptop is also a lower specification than the standard workstation as they are generally used by senior staff who have little need to do CAD work or graphics: high energy tasks.

The rest of the workstations are older machines slowly being phased out, except for the Macs used by graphics department. There was no opportunity to measure these machines to date. Four of the workstations use iiyama monitors which measure 0.445kWh in 24hrs, almost 7 times more energy than the standard Dell monitor. AFR is in the process of phasing these out.

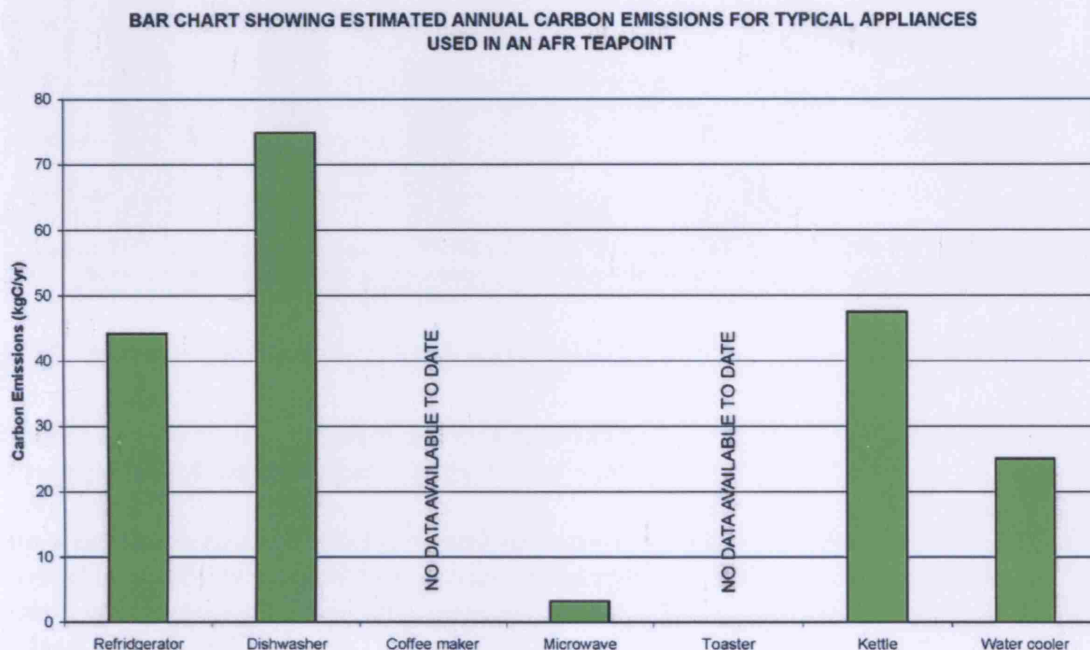


Fig. 14: Bar chart showing annual energy consumption due to appliances used in teapoints at AFR.

There are 8 teapoints across both offices. They typically have one each of the following: a refrigerator, a dishwasher, a coffee maker, a microwave, a toaster, a kettle and a water cooler. Of the teapoint appliances measured the dishwasher uses the most energy with the kettle second. Both of these use energy to heat water and this needs a lot of energy. It has not been possible to date to measure the energy for toasters and coffee-makers. The toasters are only used occasionally use so will have little effect on energy consumption but the coffee makers are used regularly both by staff and for meeting and would be worth measuring.

There are 29 printers, plotters and scanners across the two offices contributing to approximately 18900kWh and 2218kgC per annum which is 27% of appliance annual energy and 4% of the total office energy. See table 5. There is not enough variety in the office machines and not enough readings were taken to make any judgements between makes of machines.

BAR CHART SHOWING ESTIMATED ANNUAL CARBON EMISSIONS FROM TYPICAL AFR PRINTING, PLOTTING & SCANNING EQUIPMENT

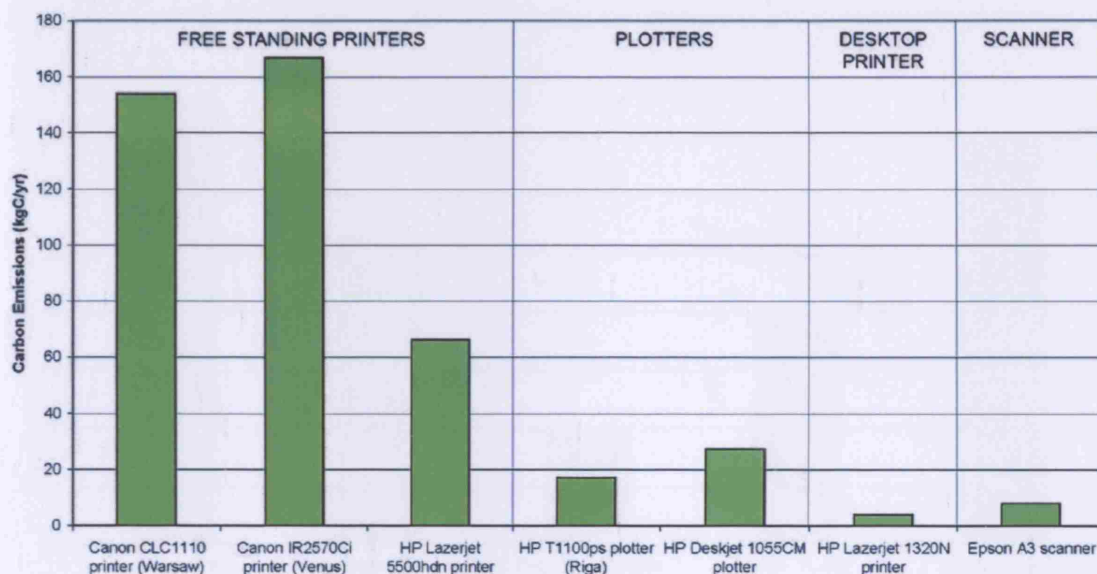


Fig. 15: Bar chart showing annual energy consumption due printers, plotters and scanners at AFR.

A meter such as the ones used in this testing would be a very useful acquisition for the assessing of all future appliances. 'Sparometers' cost around £60 each.

One way to save appliance energy would be to turn off machines rather than leave them on standby. Just turning off monitors, printers and plotters at night and at weekends and water coolers over weekends, could save between 2.3 and 2.7MWh per annum which is between 270 and 320kgC and £120-40.

Energy due to Staff travel for work purposes

This data was not available for this audit. Next year expenses forms will be used to estimate the annual transport energy used. Distances and transport types will be used with conversion factors set by DEFRA.⁴³

Water

Using water bills the water consumption in 2006 for Devonshire Street measured 560m³ and for Regent Street 441m³.

For comparison the survey uses CIRIA document C657 which has benchmarks expressed per square metre or per person. The Devonshire St. results per square metre, excluding the flats area, show that actual consumption is as typical but when looking at values per person actual consumption is as in excess figures. The cellular nature of the offices means low occupancy in relation to floor area therefore the 'per person' rate is likely to be the more accurate. The audit has therefore used the per person data in figure 16.

Devonshire Street used 7.7m³/pn and Regent Street, 5.3m³/pn. This equates to excessive water use at Devonshire Street and more than typical for Regent Street.

⁴³ DEFRA: Passenger transport emission factors: Methodology paper. 2007. DEFRA.

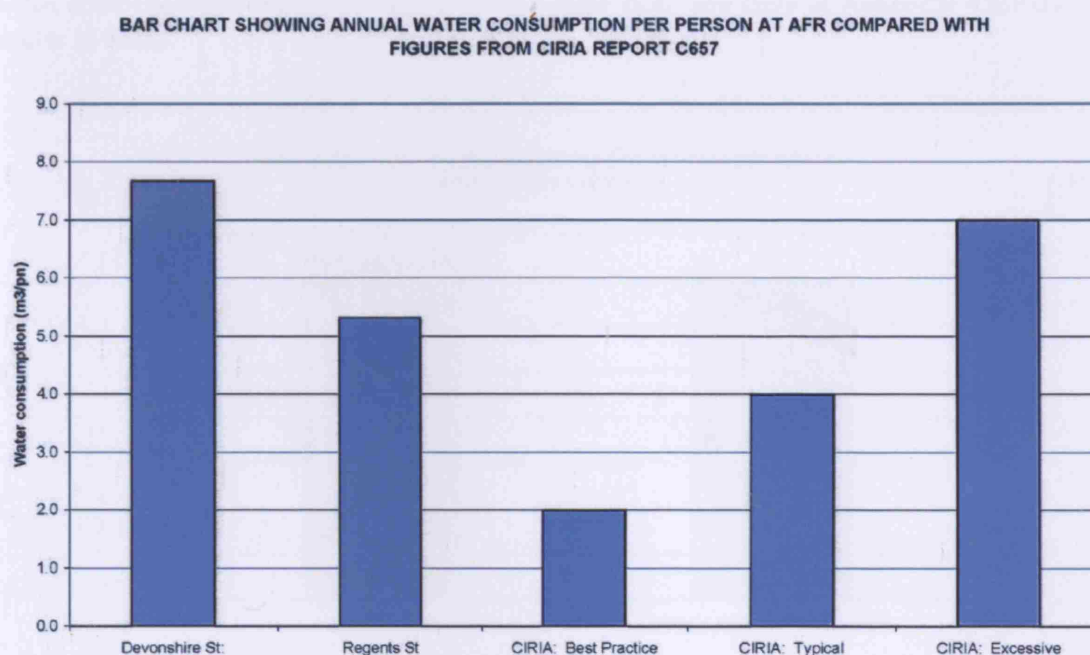


Fig. 16: Bar chart showing water consumption at AFR for 2006.

All offices are required to have metered water. Water bills with a full 12 months of readings were available for both 13 and 14 Devonshire Street. Only a single bill which covered 25 days was received from the Landlord's management company for Regent Street, this was multiplied up pro rata to cover a full year. The Devonshire Street figure can be considered accurate but the Regent Street figure should be treated as a very rough estimate.

There is little that can be done in leased accommodation to change fittings, depending on the actual lease agreement. It would be possible to reduce flush water by adding 'Save-flush bags'⁴⁴ to displace water in each cistern. Typically traditional cisterns hold about 6 litres of flush water. This can be reduced to 4.5 litres.⁴⁵ It is also possible to fit champagne roses to most taps to decrease volume but maintain coverage. Staff awareness could be improved. When dishwashers need replacing, new machines could be chosen with regard to their reduced water consumption. Existing machines might also have a water economy cycle.

Waste

The major waste type disposed of AFR is paper. This is born out by the invoice survey in the next section. To get a rough idea of how much paper AFR is producing, a survey was carried out. The paper was collected separately in orange bags over a single day and the resulting bags weighed. The total weight was multiplied up from 1 to 252 working days to give a total of 7.5 metric tonnes of paper per year across both offices.

The amount of paper discarded can vary hugely from day to day. Building up to a project submission, very little paper is discarded but after a submission is issued and the teams clear up there can be large quantities. There were no major project issues prior to either survey day but it can be seen that 1st front and rear in Regent Street and 1st floor in 14, Devonshire

⁴⁴ CLG/DEFRA *Water Efficiency in new buildings: A consultation document*. 2006. CLG.

⁴⁵ Lauchlan, C, Griggs, J & Escameia, M. BRE IPI/04: *Drainage design with reduced water use*. Jan. 2004. BRE.

Street took the opportunity to have a bit of a clear out. See table in Appendix 4 for the results in detail.

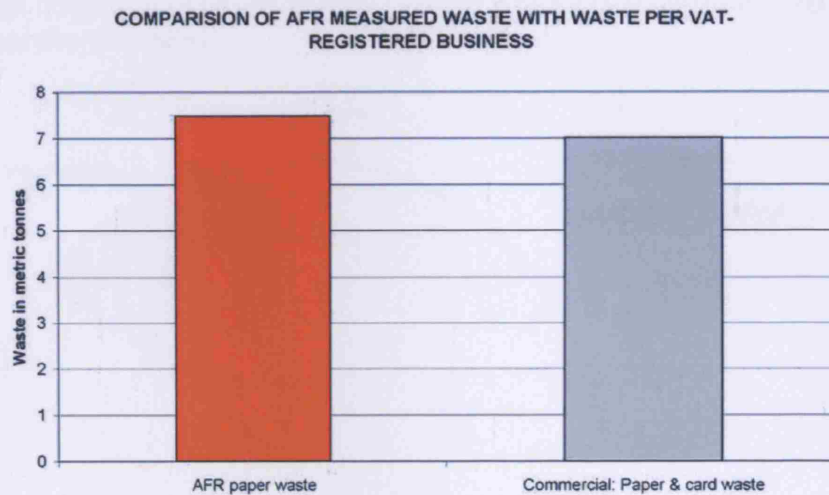


Fig. 17: Bar chart showing paper waste consumption at AFR for 2006.

No suitably recognised benchmarks have been found to date, August 2007 but using figures from National Statistics Online which states that there is 11.5Mt⁴⁶ of commercial paper waste annually. By dividing this by the number of VAT-register businesses in the UK, rough average waste paper level of 7tonnes can be estimated, half a tonne less that the AFR figure calculated.

These figures are very rough. By the next audit it is intended that paper will be recycled rather than sent to landfill and accurate figures for the waste will be provided by the recycling contractor. It is also a target to get all other waste measured by the next audit and work towards zero disposal to landfill

Specific to electrical & electronic equipment, the WEEE directive⁴⁷ came into force on 5th January 2007. It requires that all electrical and electronic equipment be recycled by an accredited waste management company and the disposer keep records of what and how all the 'WEEE' was disposed: an example of a legal requirement relevant to an aspect. AFR has already contracted Dell to deal with the recycling of the IT equipment but work needs to be done to ensure all other appliances are treated similarly.

Supplies

To get an idea of products purchased, the administration staff were asked to provided photocopies of all their purchases for one month, from February to March 2007. This was intended to be a sample of consumption, not an accurate list of all purchases. Products could be grouped into 5 categories as shown in Figure 18. 86% of all purchases in the month surveyed were stationary, of which 44% was paper.

⁴⁶ National Statistics Online. *Commercial waste figures, 2002-3.*

<http://www.statistics.gov.uk/STATBASE/ssdataset.asp?vlnk=5329>

⁴⁷ WEEE regulations 2006. *Waste Electrical and Electronic Equipment (Waste Management Licensing) (England and Wales) Regulations 2006 SI 3315*

The choice of supplies should take into account the embodied energy, the sustainable use of resources, fair use of labour, use of pollutants, life in use, maintenance in use, any energy in use & potential for reuse or recycling as well as minimum use of packaging to avoid waste. There is large collection of environmental labelling which covers various parts of this list but no one comprehensive label.

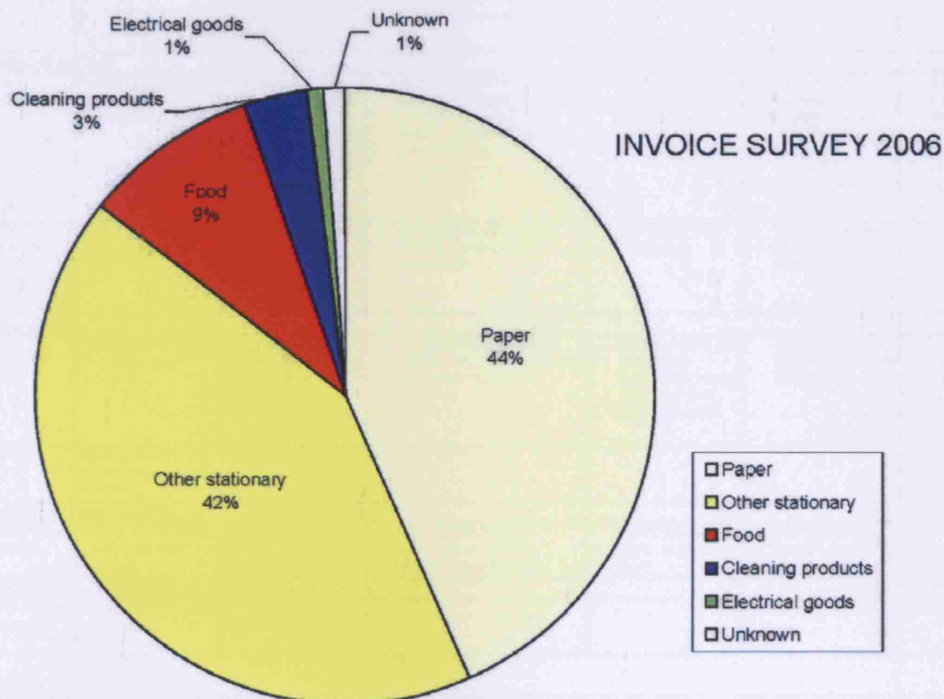


Fig. 18: Pie chart using invoice survey information to show significant types of supplies at AFR 2006.

This year AFR intends to spend their effort ensuring that all its repeat order paper is labelled FSC and/or recycled.⁴⁸ They also need to implement the procedure to review products and create a preferred list.

Community

This section covers the social aspects of sustainability. It covers the health and happiness of staff and the wider community, raising awareness of environmental issues with staff and the wider community and the promotion of wildlife and biodiversity within the office boundaries and for the wider community.

No monitoring or measurements were taken for this audit but in the future it is hoped that in part this will be covered by a short staff satisfaction survey as part of the staff reviews which happen every 6 months. AFR already provides activities which come under this heading but without feedback as to how successful they are.

⁴⁸ DEFRA. A Shopper's Guide to Green Labels: Understanding environmental labels on products. <http://www.defra.gov.uk/environment/consumerprod/glc/index.htm>

Aspects	Objectives	Targets	Programmes	Indicators	Operational Control	Monitoring & measurement
ENERGY						
Operation of Gas boilers						
Consumption of gas for space heating and hot water	Reduce consumption of non-renewable resources	improve understanding of controls to produce comfort conditions to reduce gas consumption. Target is to reduce carbon emissions by 5% by 2008 audit	<ul style="list-style-type: none"> Make study of boiler thermostats & controls window opening regimes air leakage from buildings & use of Regent St. and units individual heaters & fans to minimise fossil fuel usage 	<ul style="list-style-type: none"> Consumption of gas in kWh Comfort parameters in test space 	<ul style="list-style-type: none"> Monitoring as set by study Monthly progress review Inclusion in next annual audit 	<ul style="list-style-type: none"> Water readings & gas bills Temperature & RH readings compared with external
Use of artificial lighting						
Consumption of electricity for lighting	Reduce consumption of non-renewable resources	improve natural daylighting by carrying out awareness campaign about use of internal blinds to help reduce electricity consumption	Make study and carry out awareness campaign to use of internal blinds to improve daylight & reduce reliance on artificial lighting	<ul style="list-style-type: none"> Consumption of electricity in kWh Hours using artificial lighting during test period 	<ul style="list-style-type: none"> Monitoring as set by study Regular review in monthly meetings Inclusion in appropriate management reviews 	<ul style="list-style-type: none"> Daylight study Water readings Electricity bills Multiple device records of temperature & RH
Consumption of electricity for lighting	Reduce consumption of non-renewable resources	Eliminate use of tungsten bulbs by 2007 audit & help reduce electricity consumption	Replace all tungsten bulbs with low energy compact fluorescent	Number of bulbs purchased	Review of records as part of supply procedure	Supply procedure
Use of appliances						
Consumption of electricity for appliances	Reduce consumption of non-renewable resources	Reduce standby energy consumption to minimum by 2008 audit	Complete standby study to show how to minimise standby energy overnight and weekends	<ul style="list-style-type: none"> Increased staff awareness Compliance checks Consumption of electricity in kWh 	<ul style="list-style-type: none"> Tightly monitoring Review of electricity bill quarterly 	<ul style="list-style-type: none"> Tightly monitoring of appliance status Review of electricity bills
Consumption of electricity for appliances	Reduce consumption of non-renewable resources	See Supplies section				
Work related transport energy						
Consumption of fuel for transport	Reduce consumption of non-renewable resources	Collect data for the setting of targets in 2007 audit	<ul style="list-style-type: none"> Revise expense forms Review expense forms annually as part of audit 	<ul style="list-style-type: none"> Distance travelled & type of transport used 	<ul style="list-style-type: none"> Reviewed every 6mths & part of annual audit 	<ul style="list-style-type: none"> Review of expense forms
Transport energy due to staff travelling to and from work						
Consumption of fuel for transport	Encourage staff to use less energy	See Community Section				
WATER						
Use of toilets						
Consumption of water for flushing toilets	Conservation of water resources	Lower water consumption by 10% from 2006 levels by 2007 audit	<ul style="list-style-type: none"> Add 'Save flush tags to bottom to decrease flush volume Buy dual flush toilets when replacing or adding new 	<ul style="list-style-type: none"> Volume of water used 	<ul style="list-style-type: none"> Reviewed every 6mths & part of annual audit 	<ul style="list-style-type: none"> Review of water bills
Use of sinks and basins						
Consumption of water for washing	Conservation of water resources	Fit champagne roses to taps and ensure fitted plugs by 2008 audit	<ul style="list-style-type: none"> Fit champagne roses to taps where possible Ensure all basins & sinks have fitted plugs New basins & sinks to be mirror quality for job 	<ul style="list-style-type: none"> Volume of water used 	<ul style="list-style-type: none"> Reviewed every 6mths & part of annual audit 	<ul style="list-style-type: none"> Review of water bills
Use of dishwashers						
Consumption of water for washing	Conservation of water resources	Use most water efficient programs available by 2008 audit	Identify most water & energy efficient cycle available in each machine and train staff to use it	<ul style="list-style-type: none"> Volume of water used 	<ul style="list-style-type: none"> Reviewed every 6mths & part of annual audit 	<ul style="list-style-type: none"> Spot checking of machine settings Review of water bills
WASTE						
Paper waste						
Generation of solid waste	Reduction of waste to landfill	Zero paper waste to landfill by Christmas 2007	<ul style="list-style-type: none"> Train use of double sided printing as default setting Offer crates for internal paper reuse to board for approval 	<ul style="list-style-type: none"> Weight of paper collected 	<ul style="list-style-type: none"> Reviewed every 6mths & part of annual audit 	<ul style="list-style-type: none"> Recycling contractor records
Disposal of waste electrical & electronic equipment						
Generation of solid waste	Reduction of waste to landfill	See Supplies section				
Other waste						
Generation of solid waste	Reduction of waste to landfill	Zero waste to landfill by date to be agreed	<ul style="list-style-type: none"> Identify waste types & volumes Identify any possible inhouse reuse or recycling Provide quotes for board approval for the remaining waste 	<ul style="list-style-type: none"> Quantity & type of wastes produced Recycling contractor's quotes 	<ul style="list-style-type: none"> Monthly progress review Inclusion in next annual audit 	<ul style="list-style-type: none"> Waste study

Table 2a: First half of AFR's list of 'Aspects' showing objectives, targets, monitoring and measuring for 2007 and beyond. (enlarged version in appendix I)

Aspects	Objectives	Targets	Programmes	Indicators	Operational Control	Monitoring & measurement
SUPPLIES						
Paper						
Use of energy due to fossil fuels, Use of resources, Use of labour, Use of pollutants, Use of packaging generating waste	To try to use products with low embodied energy, sustainable use of resources, fair use of labour, no pollutants, no unnecessary packaging, long life in use, no disposal in landfill	Ensure all paper supplies have FSC and/or recycled labelling by 2008 audit	<ul style="list-style-type: none"> Identify repeat supplies Ensure all paper is reviewed using Supply Procedure 	<ul style="list-style-type: none"> FSC or PEFC labelling Recycled labelling (NB %age of new wood pulp required to maintain quality) 	Monthly progress review. Inclusion in annual audits & management reviews	Paper review
Appliances						
Use of energy due to fossil fuels, Use of resources, Use of labour, Use of pollutants, Use of packaging generating waste	To try to use products with low embodied energy, low energy in use, sustainable use of resources, fair use of labour, no pollutants, no unnecessary packaging, long life in use, disposal in compliance with WEEE regulations	Find appropriate waste management procedures for all appliances. Develop procedure for purchasing new appliances by 2007 audit	<ul style="list-style-type: none"> Develop appliance procedure from purchase to disposal Train appropriate staff to manage procedure Run procedure 	<ul style="list-style-type: none"> Spatometer readings of typical usage European energy labelling A Energy saving recommended label Energy star label (low standby energy) Quantities waste 	Monthly progress review. Inclusion in annual audits & management reviews	Appliance supplies Procedure
Other Supplies						
Use of energy due to fossil fuels, Use of resources, Use of labour, Use of pollutants, Use of packaging generating waste	To try to use products with low embodied energy, sustainable use of resources, fair use of labour, no pollutants, no unnecessary packaging, long life in use, no disposal in landfill	Set up Supplies Procedure for purchasing new supplies by 2007 audit	<ul style="list-style-type: none"> Develop supplies procedure from purchase to disposal Train appropriate staff to manage procedure Run procedure 	Labelling as shown in DEFRA shoppers guide**	Monthly progress review. Inclusion in annual audits & management reviews	Supplies Procedure
COMMUNITY						
Staff projects						
Staff happiness & fair use of labour	Promotion of staff health & happiness	Carry out staff survey for future objectives & targets in 2008	<ul style="list-style-type: none"> Develop a short survey to elicit staff feelings about their office activities Agree survey wording with board Carry out survey as part of staff reviews 	<ul style="list-style-type: none"> Staff satisfaction Suggested improvements to work & office environment 	8mth reviews & inclusion in annual audits & management reviews	Staff survey in staff reviews
Staff bicycle incentive						
Consumption of fossil fuels for transport & staff health	Encourage staff to use less transport energy & take more exercise	Review staff take-up for target setting in 2008	Include in staff survey	<ul style="list-style-type: none"> Staff take up Staff satisfaction 	8mth reviews & inclusion in annual audits & management reviews	Staff survey in staff reviews
Staff team sports						
Staff health	Encourage staff to take exercise	Review current team sports & staff take-up for target setting in 2008	Review current team sports & staff take-up using staff survey	<ul style="list-style-type: none"> No of activities Staff take up Staff satisfaction 	8mth reviews & inclusion in annual audits & management reviews	Staff survey in staff reviews
Staff transport to & from work						
Awareness & consumption of fossil fuels for transport	Increase staff awareness of environmental issues & encourage staff to use less energy	Carry out awareness campaign and provide means of comparing transport types by extent of their carbon emissions	Use intranet, email & CPD to raise staff awareness. Include tool for calculating carbon emissions for transport on intranet. Upon completion of campaign include in staff survey to show effectiveness of campaign	<ul style="list-style-type: none"> Kilometers travelled Type of transport Change in transport type over time 	8mth reviews & inclusion in annual audits & management reviews	Staff survey in staff reviews
Community projects						
Community health, happiness and awareness	Promote use of local business, reduce emissions due to transport & reduce need for packaging. See also Other Supplies.	Produce list of preferred local suppliers for 2008	Carry out survey and develop list of preferred local suppliers for 2008	<ul style="list-style-type: none"> Staff satisfaction with food provided Quantity of packaging material per order Transport used 	Part of supplies procedure. Monthly progress review. Inclusion in annual audits & management reviews	Spot checks as part of supplies procedure from purchase to disposal
Plants & wildlife						
Wildlife & biodiversity	Promotion of wildlife & biodiversity of the office & its surrounding neighbourhood	Set objectives & targets in audit to be agreed	Carry out study of existing planting within the office in its external spaces and develop targets for date to be agreed	To be identified	Annual review with audit	To be identified

* DEFRA Shoppers guide to green labels: Understanding environmental labels on products <http://www.defra.gov.uk/environment/consumerprod/glo/index.htm>

Table 2a: Second half of AFR's list of 'Aspects' showing objectives, targets, monitoring and measuring for 2007 and beyond. (enlarged version in appendix 1)

The company has a range of team sports which it supports, for example: Summer softball, 5-a-side football, golf and cricket and the office summer party which usually involves team games. These promote exercise and social interaction between staff.

This year AFR have introduced an offer to pay half the cost of any bicycle purchase made to provide transport to and from work. This should increase the fitness of the participants and may reduce their carbon emissions due to transport fuel as well. They also hope to carrying out an awareness campaign to increase awareness of transport energy and provide a calculator in the intranet to allow all staff to calculate they emissions due to transport should they so wish.

For community health and happiness: as a start AFR intend to carry out a survey of local suppliers for food for office meetings. The supplies will have to follow the supplies procedure which should help raise awareness of environmental issues as well as increase interaction with the local community and possibly eliminating the need for waste packaging and fossil fuelled transport if only for the first step back in the supply chain.

It is intended that wildlife and biodiversity will be considered in future audits.

Having completed this first audit, a table was created to match as closely as possible table A.2 in the ISO 14004⁴⁹ companion standard. See table 2. It sets out AFR's aspects with objectives and targets for each one and how AFR intend to monitor and measure them for the 2007 audit due in February 2008. This is now ready for the next stage in the process. AFR hope appoint an external auditor and carry out a gap analysis in October 2007.

⁴⁹ Page 37. British Standards Institute: *BS ISO 14004: 2004: Environmental management systems - General guidelines on principles systems and support techniques*. BSI

DISCUSSION

The results of the audit show that there is a lot of scope for improvement. AFR is a fairly typical architects office but it has high results for all the aspects measured and benchmarked. In the background section a rough calculation was made to see how much reduction in carbon emissions be needed to meet the Government 2050 target if it was split evenly between all VAT-registered businesses. The value came to 38.6tC. If AFR could reduce its energy consumption to the good practice level given in ECON19, the reduction would be 64% of 38.6tC.

The casestudy implementation team had difficulty identifying aspects, despite having some knowledge of environmental issues. The guidance is minimal in both the ISO14001 annex and in ISO14004. It is assumed that this is because the standard needs to be relevant to any country in the world and any type of business. National casestudy information would be a great help with this process. Accredited auditors would have this sort of knowledge once they had carried out a reasonable body of work. Businesses which can afford to be certified can take advantage of this information but smaller businesses might find this difficult to justify. It would also be difficult for businesses without particular environmental knowledge to find appropriate methods of quantifying the aspects and benchmarks with which to compare them. In the UK there is a lot of information available but there is no one place to look for it. This is country specific information therefore outside the remit of the standard.

In the UK there is good information available for benchmarking most of AFR's aspects, but nothing was found for supplies. Many agencies, like the Carbon Trust and the Forest Stewardship Council, have developed environmental labelling for products but none yet cover all the issues. A single comprehensive national scheme would make the choice of products much easier for business.

The aspect most difficult to meaningfully quantify is energy. For freehold properties it is easy to get hold of annual fuel bills but for leasehold properties this can be difficult. Having worked out an organisation's total energy, it is difficult to split this down into sufficient detail to inform objectives and targets. Space heating is a significant fraction of AFR's energy but as the properties are leasehold they have little control over the services, as control is in the hands of the landlords who have little incentive to improve them. New buildings can be installed with a building management system, BMS. These vary hugely, dependant on their components. A good BMS could avoid the need for reviewing fuel bills by providing audit information automatically. It could even react to the results automatically to control light levels and appliances as well as heating, cooling and ventilation.

Both of the certified companies interviewed were large enough to have dedicated teams to manage their environmental managements systems. Certification and ongoing reviews, and with, say, at least one dedicated member of staff, would give total running costs in tens of thousands of pounds. This would suggest that only larger companies would want to take up certification. Smaller companies might want to self certify but there would be no proof that they are operating the system correctly, so the commercial incentive would be much less. The lack of specific guidance information might mean that only businesses with a resident expert or enthusiast would attempt to use the standard.

Another way to reduce carbon emissions is to use carbon off-setting. This assumes that all companies have shares in a sustainable level of carbon emissions and companies who under use their shares can trade them with companies who over produce. This could be very

useful for companies for which modern technology is not enough to reduce the carbon emissions to sustainable levels but there is a risk that this trading system could be used to avoid having to work towards being sustainable. The UK draft plan, under the European Union Emissions Trading Scheme, published in January 2007 gave a figure of €5/tCO₂ (£12.43/tC) but according to the publication, Carbon Finance, brokers are trading at around €13/tCO₂ (£32.34/tC). Using these figures and the total carbon emissions from the AFR audit, it can be shown that the cost of off-setting for AFR would be at the least £570 and more likely in the region of £1484. It is early days with off-setting but the current low price of trading means that it is much easier and cheaper to pay to off-set AFR's total emissions than to manage a system to make environmental improvements.

The standard is a good one but suffers from having such a broad remit. Because it has to work for every country and every organisation type, it needs to be so generic as to require expert knowledge to ensure compliance. It also asks for a significant level of documentation. The scope for the aspects is fairly comprehensive except for one area. Sustainable development has a social dimension as well as an environmental and economic one as stated in Part I of this report. The standard only requires the management of the environmental issues. It does mention wildlife and biodiversity in the guidance but there is no mention of aspects in relation to human health and happiness.

CONCLUSION

Working through the requirements of the standard, particularly the carrying out of the audit, gave a much more detailed understanding of the casestudy organisation's impacts on the environment.

The standard itself gives a robust method of improving environmental impacts. With the inclusion of social sustainability, it would be a very comprehensive coverage of sustainability issues. For those who do choose to use ISO14001, there are a few things that would make running the system easier:

- Appropriate environmental labelling of products would help with the choosing of supplies.
- UK legislation to improve energy monitoring and encourage the reduce fuel costs, particularly in leasehold properties, to help in the reduction of carbon emissions.

The standard is not easy to implement and costs a significant amount of money to run, especially if the company chooses to certify. For larger companies, especially those who have international offices, certification under the standard makes some commercial and environmental sense. However, this is somewhat undermined by the low cost of carbon off-setting which allows business to state they are carbon neutral without doing anything to improve the environment. For smaller companies, it is hard to see why they would use the system. This would be greatly improved if some way could be found to make specific local information available to help with the core managed elements. Specific casestudies and system templates could help to reduce system development time and costs.

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Appendix I: Interviews and Casestudy information

Interviews with companies certified under ISO14001

INTERVIEWS Held: 16/8/07		Mott MacDonald (Rick Landon)	WS Atkins (Keith Sarney)
	Description of company	Multi-disciplinary & international company providing large building projects like Wembley stadium; Rabi oilfield, Gabon; Cruach Mhor Windfarm, Scotland; & terminal 5, Heathrow.	Started as a structural & civil engineering company. Now a Multi-disciplinary & international company providing large building projects such as Burj Al Arab hotel, Dubai & Manchester metro link;
	No. of employees	11000	16000
1. General	What year were you certified?	2002 (EMS set up 1999)	2003
	Roughly how long did it take to set up?	For certification quite quick because already had EMS from 1999	Some time. Each business certified separately. 60 certificates
	Were you involved in the setting up process?	Only the 2004 version	In overall charge of 14001 in the company as well as 18001 & 9001
2. Certification	Why did you choose to be certified?	Client pressure	Both market pressure and internal desire
	How did you choose your auditor?	Originally don't know but recently changed and that was having seen how good other company's assessor were.	On basis of accreditation and broad spectrum of organisation types.
	Has being certified improved your business & how?	Not necessarily certification but definitely EMS. Certification did cause process to be done more carefully. Has saved energy but not necessarily money.	Greater awareness and various small improvements
	Did you certify using the 1996 version?	Yes	Yes
	If so, have you upgraded to 2004?	Yes	Yes
	What were the major things you updated?	Not all divisions are certified - only the ones which have a commercial incentive to do so. The rest comply with the EMS but are uncertified.	
3. Framework	How do you manage the 14001 process?	Have a dedicated EMS team headed by a senior manager who reports to one of the main boards. Office & project ems treated separately.	There is a common framework and policy but individual manuals, aspects & legal requirements per business/ certificate
	What do you monitor and how?	Buildings are monitored as best as available data allows. Some buildings owned, leased etc. Use typical methods for CO2 different per building. Some teams more conscientious & weigh paper. FSC where possible for example	Varies. Dependant on the business eg asset management compared with road building. Road building may take 2 years and have on site responsibilities and asset management may be for 25 years with few site visits.
	How do you set your targets?	Targets set annually based on what is easy and without too much expenditure.	Reviewed every 6 months with audit. Some things identified are resolved immediately and others may involve more long term planning over 18mths to 2yrs.
	Did you encounter problems setting up?	Yes	Yes

	If so, what were they?	With relating legal requirements to aspects, particularly abroad.	Generally lease buildings therefore energy information can be sketchy or non-existent. About to sanction communications with landlords to install individual meters at Atkins cost to make monitoring more accurate.
4. Policy	How often do you review & update your policy?	When major changes have happened in the company.	
	Is your policy available for public viewing?	Available to view in the office only	Available in internet
5. Aspects	How did you identify your aspects?	Separate for office & projects	In house environmental team provided training to each business in aspect identification. By business, projects and office combined.
	Did you encounter problems identifying them?	None	Travel a key aspect. Awareness has reduced some travel but not quantified. Company encourages cycling.
	If so, what were they?		
6. Legal requirements	How do you identify your legal & other requirements?	Abroad tend to find a local partner whether individual or company to supply the legal requirements information. In the UK already had a basic list. Now team creates worksheets including relevance & the project manager has the responsibility to	Have 5 person strong team whose sole job is the track upcoming legislation and update the company of compliance requirements & dates.
	Did you encounter problems identifying them?	Yes	No
	If so, what were they?	See set up problems	

Description of AFR buildings

A summary of the key information about the buildings themselves is given below:

Devonshire St.

- General: Made up of two Victorian properties spread over 5 floors, 4 above ground and one level of basement. The two top floors are designated by Westminster council as residential accommodation, although they have no separate entrance. They cannot be used as office space and are generally empty with occasional use as meeting space. The gross area is 1439m², of which 393m² correspond to the top two floors. The actual occupancy on the day surveyed was 73 people. The maximum occupancy in its current arrangement would be 164 assuming all the meeting rooms were filled to capacity.
- Building envelope: Solid masonry with a mixture of casement leaded lights and sash windows, all single glazed and with high infiltration rates.
- Daylight: Shallow plan building with high ceilings and big windows to cellular offices which should indicate high use of natural light but the south facing elevation uses artificial light in conjunction with internal blinds to reduce glare. The basements have restricted daylight.
- Heat/cool/ventilation: They are naturally ventilated, using windows, with a gas boiler and radiators for heating. There is no cooling.
- Artificial lighting: The lighting is a mixture of domestic tungsten and other decorative lighting where fixed. The main office areas are lit by freestanding

downlights. There is a variety of more decorative lighting on the ground floor reception area and the adjacent meeting rooms.

Regent St.

- General: AFR occupy 4 office areas, two at 1st floor level and one area on each of the 2nd and 3rd floors. Other businesses occupy other parts of the building and it is managed by a management company for the landlord. AFR do not receive utility bills directly, they are covered in the management charge. Gross leased area is 608m². The actual occupancy on the day surveyed was 83 people. The maximum occupancy in its current arrangement would be 133 assuming all the meeting rooms were filled to capacity.
- Building envelope: Regent Street is built in round about the 1930s. It is concrete frame and stone clad at the front, on Regent Street, and back, with brick facings to the central light well. The windows to the first rear office and a small portion of the 3rd floor are recently replaced with double glazing. It is assumed that the metal frames are thermally broken and the specification of the glazing is unknown. Generally the windows are single glazed metal casements without thermal breaks.
- Daylight: The depth of the floor plates and the area of glazing are generally looks sufficient⁵⁰ for natural daylighting for a good proportion of the time but the lack of external shading mean that the internal blinds tend to be used in conjunction with artificial light.
- Heat/cool/ventilation: The ventilation is mainly natural, using windows, but augmented by a small amount of mechanical ventilation to stagnant areas. Heating is provided by gas boilers and radiators and each office area has an individual wall mounted air conditioning unit for summer cooling.
- Artificial lighting: The office areas have fairly recent false ceilings with an even distribution of fluorescent downlight.

⁵⁰ There is a good ratio of glazing to floor depth.

Aspects	Objectives	Targets	Programmes	Indicators	Operational Control	Monitoring & measurement
ENERGY						
Operation of Gas boilers						
Consumption of gas for space heating and hot water	Reduce consumption of non-renewable resources	Improve understanding of controls to produce comfort conditions to reduce gas consumption. Target is to reduce carbon emissions by 5% by 2008 audit.	Make study of: <ul style="list-style-type: none"> boiler thermostats & controls window opening regimes air leakage from buildings & use of Regent St. a/c units, individual heaters & fans to minimise fossil fuel usage. 	<ul style="list-style-type: none"> Consumption of gas in kWh Comfort parameters in test space 	<ul style="list-style-type: none"> Monitoring as set by study Monthly progress review Inclusion in next annual audit 	<ul style="list-style-type: none"> Meter readings & fuel bills Temperature & RH readings compared with external
Use of artificial lighting						
Consumption of electricity for lighting	Reduce consumption of non-renewable resources	Improve natural daylighting by carrying out awareness campaign about use of internal blinds to help reduce electricity consumption.	Make study and carry out awareness campaign to use of internal blinds to improve daylight & reduce reliance on artificial lighting	<ul style="list-style-type: none"> Consumption of electricity in kWh Hours using artificial lighting during test period 	<ul style="list-style-type: none"> Monitoring as set by study Regular review in monthly meetings Inclusion in appropriate management reviews 	Daylight Study using: <ul style="list-style-type: none"> Meter readings, Electricity bills HOBO device records of temperature & RH
Consumption of electricity for lighting	Reduce consumption of non-renewable resources	Erraticate use of tungsten bulbs by 2008 audit & help reduce electricity consumption	Replace all tungsten bulbs with low energy compact fluorescents.	Number of items purchased	Review of records as part of supply procedure	Supply procedure
Use of appliances						
Consumption of electricity for appliances	Reduce consumption of non-renewable resources	Reduce standby energy consumption to minimum by 2008 audit.	Complete standby study to show how to minimise standby energy over night and weekends.	<ul style="list-style-type: none"> Increased staff awareness Compliance checks Consumption of electricity in kWh 	Nightly monitoring. Review of electricity bills quarterly	<ul style="list-style-type: none"> Nightly monitoring of appliance status. Review of electricity bills
Consumption of electricity for appliances	Reduce consumption of non-renewable resources	see Supplies section				
Work related transport energy						
Consumption of fossil fuels for transport	Reduce consumption of non-renewable resources	Collect suitable data for the setting of targets in 2007 audit	<ul style="list-style-type: none"> Revise expense forms Review expense forms annually as part of audit 	Kilometers travelled & type of transport used	Reviewed every 6mths & part of annual audit	Review of expense forms
Transport energy due to staff travelling to and from work						
Consumption of fossil fuels for transport	Encourage staff to use less energy	See Community Section				

Aspects	Objectives	Targets	Programmes	Indicators	Operational Control	Monitoring & measurement
SUPPLIES						
Paper						
Use of energy due to fossil fuels, Use of resources, Use of labour, Use of pollutants, Use of packaging generating waste	To try to use products with low embodied energy, sustainable use of resources, fair use of labour, no pollutants, no unnecessary packaging, long life in use, no disposal in landfill	Ensure all paper supplies have FSC and/or recycled labelling by 2008 audit	<ul style="list-style-type: none"> Identify repeat supplies. Ensure all paper is reviewed using Supply Procedure 	<ul style="list-style-type: none"> FSC or PEFC labelling Recycled labelling. (NB %age of new wood pulp required to maintain quality) 	Monthly progress review. Inclusion in annual audits & management reviews.	Paper review
Appliances						
Use of energy due to fossil fuels, Use of resources, Use of labour, Use of pollutants, Use of packaging generating waste	To try to use products with low embodied energy, low energy in use, sustainable use of resources, fair use of labour, no pollutants, no unnecessary packaging, long life in use, disposal in compliance with WEEE regulations	Find appropriate waste management procedures for all appliances. Develop procedure for purchasing new appliances by 2007 audit	<ul style="list-style-type: none"> Develop appliance procedure from purchase to disposal Train appropriate staff to manage procedure Run procedure. 	<ul style="list-style-type: none"> Sparometer readings of typical usage. European energy label rating A Energy saving recommended label Energy star label (low standby energy) Quantities waste 	Monthly progress review. Inclusion in annual audits & management reviews.	Appliance supplies Procedure
Other Supplies						
Use of energy due to fossil fuels, Use of resources, Use of labour, Use of pollutants, Use of packaging generating waste	To try to use products with low embodied energy, sustainable use of resources, fair use of labour, no pollutants, no unnecessary packaging, long life in use, no disposal in landfill	Set up Supplies Procedure for purchasing new supplies by 2007 audit	<ul style="list-style-type: none"> Develop supplies procedure from purchase to disposal Train appropriate staff to manage procedure Run procedure. 	Labelling as shown in 'DEFRA shoppers guide'	Monthly progress review. Inclusion in annual audits & management reviews.	Supplies Procedure
COMMUNITY						
Staff projects						
Staff happiness & fair use of labour	Promotion of staff health & happiness	Carry out staff survey for future objectives & targets in 2008.	<ul style="list-style-type: none"> Develop a short survey to elucidate staff feelings about their office activities. Agree survey wording with board. Carry out survey as part of staff 	<ul style="list-style-type: none"> Staff satisfaction Suggested improvements to work & office environment 	6mth reviews & inclusion in annual audits & management reviews.	Staff survey in staff reviews

Appendix 2: ENERGY

Table showing results of fuel bills analysis

DEVONSHIRE ST. FUEL BILLS FOR YEAR 2006/7

	kWh	GJ	kgCO ₂	kgC	Comments
Electricity	178613	643	76804	20946	Conversion factors for kgC & CO ₂
Gas	156540	564	29743	8112	from www.carbontrust.co.uk

TOTALS	335153	1207	106546	29058	Comments
Per person	4591	17	1460	398	Occ. = 73
Per m ²	253	0.9	80	21.9	TFA* = 1325 including top 2 floors

Per m ²	351	1.3	112	30.4	TFA* = 955 w/o top floors
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REGENT ST. FUEL BILLS FOR YEAR 2006/7 (ASSUMED - NO DATA)

	kWh	GJ	kgCO ₂	kgC	Comments
TOTALS	143488	517	61700	16831	based on ECON19 type 2 typ. Figs
Per person	1729	6	743	203	Occ. = 83
Per m ²	236	0.8	101	27.7	TFA* = 608

AFR FUEL BILL TOTALS FOR YEAR 2006/7

	kWh	GJ	kgCO ₂	kgC	Comments
TOTALS	478641	1723	168246	45889	Totals of Dev. St & assumed Reg. St
Per person	3068	11	1079	294	Occ. = 156
Per m ²	248	0.9	87	23.7	TFA = 1933

PER ANNUM FIGURES FROM 'ECON 19' ENERGY IN OFFICES REPORT, 1998

	Type 1		Type 2		Comments
	kWh/m ²	kgC	kWh/m ²	kgC	
Typ.	205	14.8	236	18.7	Data from 1990s Conversion factor
Good practice	112	8.3	133	11.0	different kgC values will be different
% of typ.	123	148	na	na	
% of G.P.	226	264	na	na	

* TFA = treated floor area i.e. gross floor area less plant storage areas & car park as used in ECON19

Tables showing results workstation, teapoint & printers appliance testing

ENERGY MEASUREMENTS FOR INDIVIDUAL WORKSTATIONS 2007

Type of Appliance	Qty.***	Total energy/ day, workstation	% efficiency in relation to Standard	Total emissions/ day, workstation (kgC/day)	Cost/day (£/day)	Energy/ annum (kWh _{pa})**	Total emissions/ yr, workstation (kgC _{pa})	Cost/annum (£ _{pa})**	Comments
A Standard: Dell Precision 380 w. standard Dell flatscreen	126	1.202	100	0.14	£0.06	303	36	£15.87	Typical workstation on typical day
A Standard: Dell Precision 380 w. standard Dell flatscreen	126	0.120	10	0.01	£0.01	30	4	£1.58	Typical workstation on standby.
B Graphics: Dell Precision 690 w. high spec Dell flatscreen	4	1.701	142	0.20	£0.09	429	50	£22.46	Not generally used continuously. Has additional programmes not used all the time to achieve baseline mode.
C Dell laptop	11	0.370	31	0.04	£0.02	93	11	£4.89	Measurement based on laptop used for 12.9mins. Laptops taken home at night for security. Used by senior staff.
D Compact Dell w. Dell ultra- sharp flat screen monitor	15	0.573	48	0.07	£0.03	144	17	£7.57	Older machine
E Dell Precision 380 w. ultra- sharp Dell flatscreen monitor	5	1.229	102	0.14	£0.06	310	36	£16.23	Lower spec. graphics machine
F1 RM computer w. standard Dell flatscreen monitor	6	0.569	47	0.07	£0.03	143	17	£7.51	Less powerful than the standard machine. Being phased out slowly.
F2- Various other older machines F9	14	na	na	na	na	na	na	na	Incl. Older machines being phased out slowly & 4no. Mac machines in Graphics Dept.
TOTALS 181									

* Readings taken are generally of a typical day. Figures do not take into account variations in use. Particularly graphics machines which are for

** Annual values calculated based on 252 working days. Computers & monitors are generally on standby at night & over the weekend. This figure does
not allow for energy due to standby mode at week ends.

*** This number is the total number of workstations available. The max. number used on the day of survey was 156.

ENERGY MEASUREMENTS FOR TEAPOINT APPLIANCES 2007

Type of Appliance	Energy per day (kWh ₂₄)*	Emissions per day (kgC ₂₄)	Cost per day (£ ₂₄)	Energy per yr (kWh _{pa})**	Emissions per yr (kgC _{pa})	Cost per yr (£ _{pa})	Comments
T1 Refrigerator	1.031	0.12	£0.05	376	44	£20	
T2 Dishwasher	2.532	0.30	£0.13	638	75	£33	
T3 Coffee maker		0.00	£0.00		0		Causes an error message when turned off between use
T4 Microwave	0.109	0.01	£0.01	27	3	£1	Only occasional use
T5 Toaster		0.00	£0.00		0		Causes an error message when turned off between use
T6 Kettle	1.607	0.19	£0.08	405	48	£21	
T7 Water cooler	0.586	0.07	£0.03	214	25	£11	
TOTALS PER TEAPOINT	5.865	0.69	£0.31	1661	195	£87	

* Readings taken are generally of a typical day. Figures do not take into account variations in use.

** Annual values calculated based on 252 working days or 365 days as appropriate.

ENERGY MEASUREMENTS FOR INPUT & OUTPUT 2007

Type of Appliance	Location	Qty.	Energy/unit (kWh _{eq})*	Emissions/day (kgCO ₂)	Cost/day (£ ₂₄)	Energy/annum (kWh _{eq})*	Emissions/annum (kgCO ₂)	Cost/annum (£ ₃₆₅)	Comments
Freestanding printers									
P21 Canon C1100 printer (Warsaw)	RS station	1	5.705	0.61	£0.27	1312	164	£69	Measured
P23 Canon R2570D printer (Venus)	RS station & OS 1st flr	3	5.641	0.66	£0.30	1422	167	£74	Measured
Other Canon R2570 printers		5	5.641	na	na	na	na	na	Assumed
P17 HP Laserjet 5500 printer	RS 2nd	1	2.143	0.26	£0.12	567	66	£30	Measured
Totals		13	69.5	8.15	£3.64	17514	2054	£918	
Plotters									
P9 HP 7110cps plotter (Riga)	RS station	1	0.580	0.07	£0.03	146	17	£8	Low use
P10 HP Deskjet 1566CM plotter	RS 3rd & OS B	2	0.927	0.11	£0.05	234	27	£10	Low use
P11 HP Deskjet 5000 plotter	OS B	1	0.927	0.11	£0.05	234	27	£10	Assumed higher usage
Totals		4	3.4	0.39	£0.18	847	99	£44	
Desktop printers									
P12 HP Laserjet 1320N printer	RS station	1	0.134	0.03	£0.01	34	4	£1	Measured
Other HP desktop printers		7	0.134	na	na	na	na	na	Assumed
Totals		8	1.1	0.13	£0.06	270	32	£14	
Scanners									
P19 Epson A3 scanner	RS 2nd & OS B	2	0.274	0.03	£0.01	69	8	£4	Low use
Other scanners		2	0.274	na	na	na	na	na	Assumed
Totals		4	1.1	0.13	£0.06	276	32	£14	
GRAND TOTALS:									
			(kWh _{eq})	(kgCO ₂)	(£ ₂₄)	(kWh _{eq})	(kgCO ₂)	(£ ₃₆₅)	
			29	75.0	8.80	£3.93	18907	2218	£991

Readings taken are generally of a typical day. Figures do not take into account variations in use.
Annual values calculated based on 252 working days.

Table showing how emission due to transport can be measured

CARBON EMISSIONS DUE TO TRAVEL

Source: DEFRA Passenger transport emissions factors: Methodology Paper 2007

Date	From	To	Dist	Type of transport	Conversion factor	kgCO ₂	kgC
eg							
	London	Edinburgh	509	National Rail	0.060	31	3.6
	London	Edinburgh	509	Domestic car (UK)	0.158	80	9.4
	London	Edinburgh	509	Petrol Car	0.210	107	12.5
	London Heathrow	Cape Verde	4416	Long-haul air	0.106	466	54.7
	Office West End	Streatham*	97	Moped/Scooter	0.073	7	0.8
	Office West End	Streatham*	97	Bus	0.089	9	1.0
	Office West End	Streatham*	97	Rail	0.060	6	0.7

1 mile	1.609 km
1 km	0.621 miles

Conversion factors

Domestic car (UK)	0.158	kgCO ₂ /km
Short-haul air (Eur)	0.130	kgCO ₂ /km
Long-haul air	0.106	kgCO ₂ /km
Petrol Car	0.210	kgCO ₂ /km
Diesel Car	0.199	kgCO ₂ /km
Car (fuel unknown)	0.203	kgCO ₂ /km
Moped/Scooter	0.073	kgCO ₂ /km
Motorcycle	0.107	kgCO ₂ /km
Bus	0.089	kgCO ₂ /km
National Rail	0.060	kgCO ₂ /km
Light rail/tram	0.065	kgCO ₂ /km
Underground	0.053	kgCO ₂ /km

* 97 km represents 2 journeys a day for 5 days

Appendix 3: WATER

Table showing results of water bill analysis

ANNUAL WATER 2006-7 FROM WATER BILLS

Actual	Water Consumption Dev. St	560 m ³	
	Water Consumption per m ²	0.4 m ³ /m ²	Area = 1325 m ² incl top fls
	Water Consumption per m ²	0.6 m ³ /m ²	Area = 955 m ² excl top fls
	Water Consumption per person	7.7 m ³ /pn	Occ = 73 people

Actual	Water Consumption Reg. St *	441 m ³	
	Water Consumption per m ²	0.7 m ³ /m ²	Area = 608 m ²
	Water Consumption per person	5.3 m ³ /pn	Occ = 83 people

CIRIA C657 BENCHMARKS 2006

Typical	Water Consumption per m ²	0.6 m ³ /m ²
	Water Consumption per person	4.0 m ³ /pn
Best practice	Water Consumption per m ²	0.4 m ³ /m ²
	Water Consumption per person	2.0 m ³ /pn
Excessive	Water Consumption per m ²	0.8 m ³ /m ²
	Water Consumption per person	7.0 m ³ /pn

* Regent St water usage is based on a single estimated bill & determined pro rata. High margin of error

14 1st	2.9
14 Ground	0.0
14 1st	2.9
14 2nd	2.8

10.8 kg of paper

**TOTAL PAPER WASTE FOR ONE DAY:
ESTIMATE FOR YEAR 2006-7:**

29.7 kg of paper

7484.4 kg of paper

OR

7.5 Metric Tonnes

**TOTAL WASTE PAPER PER PERSON
TOTAL WASTE PAPER PER SQ. METRE**

48.0 kg/pn.yr

3.9 kg/m2.yr

Based on a single days data in each office. There is likely to be a wide margin of error.

Appendix 5: SUPPLIES/SPECIFICATION

Table showing results of invoice survey

INVOICE SURVEY 2006

	Qty	%
Paper	42	43.3%
Other stationary	41	42.3%
Food	9	9.3%
Cleaning products	3	3.1%
Electrical goods	1	1.0%
Unknown	1	1.0%
TOTAL	97	100%

Based on invoices collected from February to March 2007